

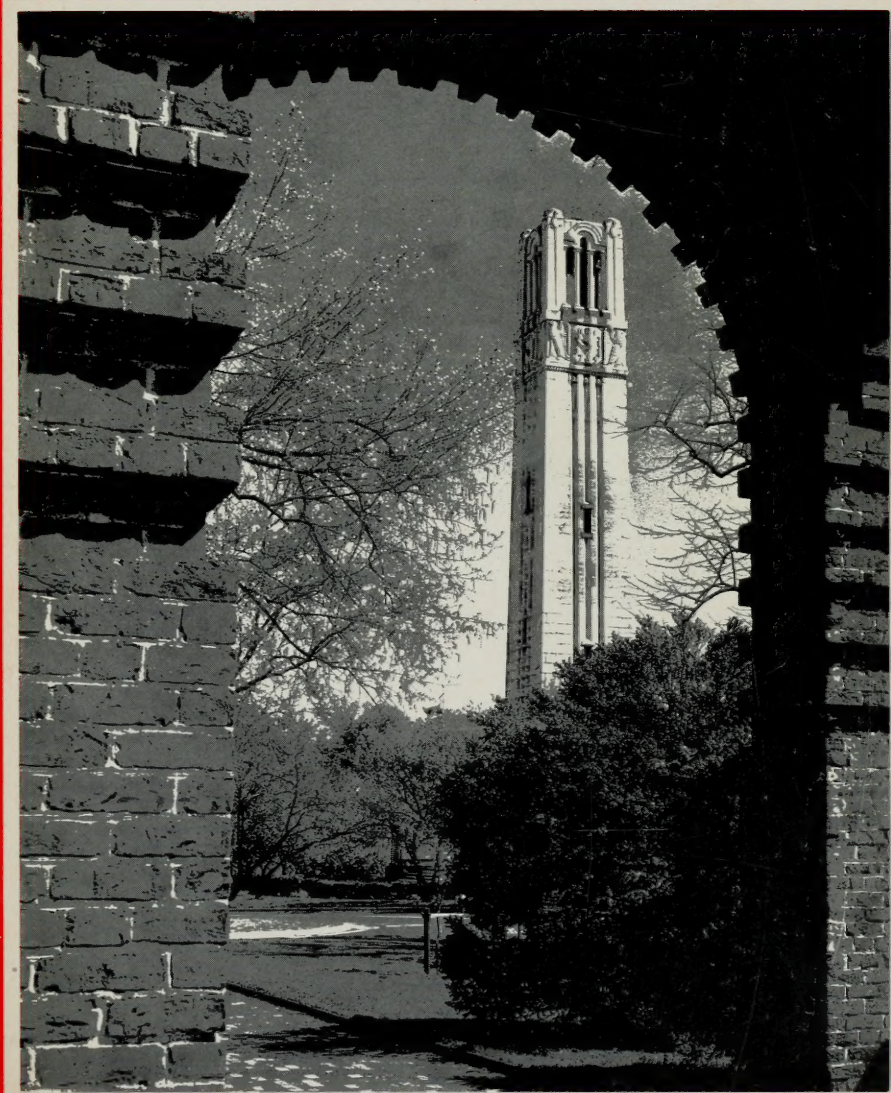
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# North Carolina State University Bulletin

1972-74



## Undergraduate Catalog

December, 1972

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**North Carolina State University**  
**Raleigh, North Carolina**

**Undergraduate Catalog**  
**1972-74**



*North Carolina State University's central campus includes 120 buildings on 596 acres, although the University has 88,000 acres. From here the University carries out its three major functions—research, extension and academic affairs.*

# THE UNIVERSITY OF NORTH CAROLINA

October 8, 1972

## Sixteen Constituent Institutions

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The University of North Carolina was chartered in 1789 and opened its doors to students in 1795. It has been governed by a Board of Trustees chosen by the Legislature and presided over by the Governor. During the period 1917-1972, the Board consisted of 100 elected members and a varying number of ex-officio members.

By act of the General Assembly of 1931, without change of name, it was merged with The North Carolina College for Women at Greensboro and The North Carolina State College of Agriculture and Engineering at Raleigh to form a multicampus institution designated The University of North Carolina.

In 1963 the General Assembly changed the name of the campus at Chapel Hill to The University of North Carolina at Chapel Hill and that at Greensboro to The University of North Carolina at Greensboro and, in 1965, the name of the campus at Raleigh to North Carolina State University at Raleigh.

Charlotte College was added as The University of North Carolina at Charlotte in 1965, and, in 1969, Asheville-Biltmore College and Wilmington College became The University of North Carolina at Asheville and The University of North Carolina at Wilmington respectively.

A revision of the North Carolina State Constitution adopted in November 1970, included the following: "The General Assembly shall maintain a public system of higher education, comprising The University of North Carolina and such other institutions of higher education as the General Assembly may deem wise. The General Assembly shall provide for the selection of trustees of The University of North Carolina . . ." In slightly different language, this provision had been in the Constitution since 1868.

On October 30, 1971, the General Assembly in special session merged, without changing their names, the other 10 state-supported senior institutions into the University as follows: Appalachian State University, East Carolina University, Elizabeth City State University, Fayetteville State University, North Carolina Agricultural and Technical State University, North Carolina Central University, North Carolina School of the Arts, Pembroke State University, Western Carolina University, and Winston-Salem State University. This merger became effective on July 1, 1972.

The Board of Trustees became the Board of Governors and the number was reduced to 35 members (32 after July 1, 1973) elected by the General Assembly. It is "responsible for the general determination, control, supervision, management, and governance of all affairs of the constituent institutions." However, each constituent institution has a local board of trustees of 13 members, eight of whom are appointed by the Board of Governors, four by the Governor, and one, the elected president of the student body, whose principal powers are exercised under a delegation from the Board of Governors.

Each institution has its own faculty and student body, and each is headed by a chancellor as its chief administrative officer. Unified general policy and appropriate allocation of function are effected by the Board of Governors and by the President with other administrative officers of the University. The General Administration office is located in Chapel Hill.

The chancellors of the constituent institutions are responsible to the President as the chief administrative and executive officer of The University of North Carolina.

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*Harrelson Hall, North Carolina State University's round classroom building is an important instructional center with the D. H. Hill Library (foreground) and residence halls (tri-dorm area) conveniently located.*

# North Carolina State University

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### STUDENTS SUPPLY STORE

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# North Carolina State University

North Carolina State University is a large and complex state university, one of the major state universities of the nation.

It shares the distinctive character of Land-Grant state universities nationally—broad academic offerings, extensive public involvement, national and international activities, and large-scale extension and research programs.

State was founded as a Land-Grant state university under terms of the famed federal Morrill Act of 1862 which provided for public land endowments to support a college in each state.

The Land-Grant heritage of fulfilling three major functions—research, extension and academic affairs—is reflected in the large dimensions of these functions at North Carolina State University.

The rich and varied academic program of the University is comprised of some 70 bachelors of arts and science programs, 62 master's degree fields and 41 doctoral degrees.

Its research activities span a broad spectrum of about 700 scientific, technological and scholarly endeavors, with a budget of over \$20 million annually.

Extension programs of the University are similarly diverse and include urban affairs, marine sciences, environmental protection, engineering industrial and textiles extension, agricultural extension and many others.

The annual University budget is about \$80 million. The University has 4,600-plus employees. There are 1,597 faculty and professional staff and 157 adjunct and federal agency faculty, including 932 graduate faculty.

There are 120 campus buildings with an estimated value of about \$120,-000,000.

The central campus is 596 acres, though the University has 88,000 acres, including one research and endowment forest of 78,000 acres. Research farms; biology and ecology sites; genetics, horticulture, and floriculture nurseries; and Carter Stadium areas near the main campus comprise about 2,500 acres.

Principal operational locations for the University in North Carolina are the Marine Sciences Center at Wilmington, the Fisheries Laboratory at Hatteras, the Minerals Industries Laboratory at Asheville, the Pamlico Marine Laboratory at Aurora, and the 20 agricultural research stations and forests.

North Carolina State University is one of the three Research Triangle Universities along with Duke University and the University of North Carolina at Chapel Hill. In the 30-mile triangle formed by the three Universities is the 5,000-acre Research Triangle Park, the Research Triangle Institute, a Universities' subsidiary, and the Triangle Universities Computation Center, a central facility for the extensive computing centers of the institutions.

The University's total enrollment is about 13,800. There are 11,250 undergraduates, 2,270 graduate students and about 300 other students. Students at State come from all 50 states and some 60 other countries. The international enrollment is a distinctive feature of the institution since its 480 international students give it a decidedly cosmopolitan aura.

North Carolina State University is organized in eight schools and the Graduate School. The eight schools are Agriculture and Life Sciences, Design, Education, Engineering, Forest Resources, Liberal Arts, Physical and Mathematical Sciences and Textiles. In addition, a complex of divisions and programs provide for a wide range of special programs in academic affairs, research and extension.

State is one of 118 recognized members of the National Association of State Universities and Land-Grant Colleges. It is also a member of the American

Council on Education, the College Entrance Examination Board, the Council of Graduate Schools in the United States, the National Commission on Accrediting, and the Southern Association of Colleges and Schools.

The University is accredited by national and regional accrediting agencies applicable to the University and its numerous professional fields.

In the fall of 1972, 65 percent of the entering freshmen were in the top one-quarter of their high school graduating classes. A total of 93 percent were in the top half of their classes. About 88 percent of all applicants are accepted. The average combined SAT score for the entering freshmen in 1972 was 1040.

Typically, the ratio of men and women students on the campus, including all graduate students and special students, is about three to one. In the fall of 1972, the Registrar's Office listed 10,709 male and 3,100 female students.

About one-third of the total student body consists of new students each fall. There were more than 4,000 in the semester this catalog was prepared. These include 2,190 freshmen, 441 special students, 736 transfer students, 58 unclassified students and 644 students who entered for graduate studies.

State has been heavily oriented to scientific and technological areas, illustrated by the designation of its schools. However, in the decade of the 1960's the rapid rise of the School of Liberal Arts and the quality of faculties in social sciences and humanities has given the University a typical major university character.

The largest schools are engineering and liberal arts. Engineering has an enrollment of 3,100 and liberal arts of just under 3,000.

With its 2,300 courses, students have the opportunity to concentrate in a broad range of studies. The new multi-disciplinary program in liberal arts permits students to design their own courses of study. The Division of University Studies offers courses of special interest to all students—courses dealing with environmental and ecological problems, the world armament problem, and the world population crisis.

# PROGRAMS OF STUDY

The 2,300 courses offered by North Carolina State University give students an unusual range of choices in degree curricula, special fields of study, degree options, and specialized concentrations.

Programs of study range from the new multidisciplinary studies program in Liberal Arts, in which students may design their own course of study under the supervision of a faculty committee, to the highly specialized sciences and technologies in engineering and biological sciences.

The 2,300 courses provide the bases for the bachelors, masters and doctoral degrees of the University but they also may be combined in sequences and concentrations to establish numerous other programs of study suiting the student's interests.

The wide variety of academic programs is indicated by the following listing of current programs of study:

Accounting  
Aerospace Engineering  
Agriculture  
Agricultural Economics  
Agricultural Education  
Agricultural Institute  
Agronomy  
Animal Science  
Architecture  
Biochemistry  
Biological and Agricultural Engineering  
Biological Science  
Botany  
Business  
Ceramic Engineering  
Chemical Engineering  
Chemistry  
Civil Engineering  
Computer Science  
Conservation  
Construction  
Criminal Justice and  
Police Services  
Crop Science  
Economics  
Education  
Electrical Engineering  
Engineering Mechanics  
Engineering Operations  
English  
Entomology  
Environmental Design  
Fisheries Option  
Food Science  
Forestry  
French

Furniture Manufacturing &  
Management  
Geology  
History  
Horticultural Science  
Human Resources Development  
Industrial Arts Education  
Industrial Education  
Industrial Engineering  
International Option  
Landscape Architecture  
Liberal Arts (General)  
Marine Sciences  
Materials Engineering  
Mathematics  
Mathematics Education  
Mechanical Engineering  
Medical Technology  
Meteorology  
Microbiology  
Multidisciplinary Studies  
Nuclear Engineering  
Philosophy  
Physics  
Plant Protection  
Politics  
Poultry Science  
Pre-Dental  
Pre-Medicine  
Pre-Veterinary  
Product Design  
Psychology  
Pulp and Paper Science  
Recreation and Park Admin.  
Recreation Management  
(Natural Resources)

Rural Sociology  
Science Education  
Sociology  
Soil Science  
Social Studies  
Spanish  
Speech-Communication  
Statistics

Technical Education  
Textile Chemistry  
Textile Technology  
Visual Design  
Vocational-Industrial Education  
Wildlife Biology  
Wood Science and Technology  
Zoology

## UNDERGRADUATE DEGREES

### **Bachelor's** degrees of:

environmental design in architecture, environmental design in landscape architecture and environmental design in product design.

### **Bachelor of Science** degrees in:

#### *Agriculture and Life Sciences*

(*Business*)—agricultural economics, animal science, crop science, horticultural science, poultry science and soil science;

(*Science*)—agricultural economics, animal science, biological and agricultural engineering, botany, conservation, crop science, entomology, food science, horticultural science, medical technology, plant protection, poultry science, rural sociology, soil science, wildlife biology and zoology (also preveterinary);

(*Technology*)—agronomy, animal science, biological and agricultural engineering, food science, horticultural science and poultry science; (*Biological Sciences*)—biological sciences.

#### *Education*

agricultural education, vocational industrial education, technical education, mathematics education, industrial arts education and science education.

#### *Engineering*

aerospace, chemical, civil, (construction option), electrical, industrial, materials, mechanical and nuclear engineering; engineering mechanics, engineering operations; and furniture manufacturing and management.

#### *Forest Resources*

forestry, conservation, pulp and paper science and technology, natural resource recreation management, recreation and park administration, wood science and technology.

#### *Liberal Arts*

economics, English, history, politics and philosophy.

#### *Physical and Mathematical Sciences*

chemistry, computer science, geology, mathematics, physics, statistics.

#### *Textiles*

textile chemistry and textile technology.

### **Bachelor of Arts** degrees in:

#### *Education*

psychology.

### *Liberal Arts*

economics, English, French, Spanish, history, politics, philosophy, sociology, speech-communication, multi-disciplinary major in Liberal Arts.

### *Physical and Mathematical Sciences*

geology.

### **Professional degrees (fifth year) in:**

chemical engineer, civil engineer, electrical engineer, industrial engineer, materials engineer, mechanical engineer and nuclear engineer.

## **GRADUATE DEGREES**

### **Master's degrees of:**

adult and community college education, agricultural education, agriculture, applied mathematics, architecture, biological and agricultural engineering, biomathematics, chemical engineering, civil engineering, economics, electrical engineering, engineering mechanics, forestry, guidance and personnel services, industrial arts education, industrial engineering, landscape architecture, life sciences, mathematics, mathematics education, mechanical engineering, product design, public affairs, recreation resources, sociology, science education, statistics, technology for international development, textile technology, urban design, vocational industrial education, wildlife biology, wood and paper science.

### **Master of Arts programs in:**

economics, English, history, and politics.

### **Master of Science programs in:**

adult and community college education, agricultural education, agricultural economics, animal science, applied mathematics, biochemistry, biological and agricultural engineering, biomathematics, botany, chemical engineering, chemistry, civil engineering, crop science, electrical engineering, engineering mechanics, entomology, food science, forestry, genetics, geology, guidance and personnel services, horticultural science, industrial arts education, industrial engineering, marine sciences, materials engineering, mathematics, mathematics education, mechanical engineering, microbiology, nuclear engineering, nutrition, operations research, physics, physiology, plant pathology, poultry science, psychology, recreation resources administration, rural sociology, science education, soil science, statistics, textile chemistry, textile technology, vocational industrial education, wildlife biology, wood and paper science, and zoology.

### **Doctor of Philosophy programs in:**

animal science, applied mathematics, biochemistry, biological and agricultural engineering, biomathematics, botany, chemical engineering, chemistry, civil engineering, crop science, economics, electrical engineering, engineering mechanics, entomology, fiber and polymer science, food science, forestry, genetics, horticultural science, industrial engineering, marine sciences, materials engineering, mathematics, mathematics education, mechanical engineering, microbiology, nuclear engineering, nutrition, operations research, physics, physiology, plant pathology, psychology, science education, sociology, soil science, statistics, wood and paper science, and zoology.

**Doctor of Education** programs in:  
adult and community college education and occupational education.

## Admissions

Applicants for admission to the University should apply to the Director of Admissions by May 1 for the fall semester and by December 1 for the spring semester. The various admissions requirements for freshman, transfer students and others are discussed elsewhere in this section. Each applicant must complete an application form which may be obtained from high school counselors.

To obtain application forms or additional information on fields of study at the University, contact:

Director of Admissions  
Box 5126  
North Carolina State University  
Raleigh, North Carolina 27607

A nonrefundable \$10 application fee must accompany the completed application when it is submitted to the Director of Admissions. Students of all races are equally welcome at the University.

The Admissions Office is in Peele Hall and is open every week day (except holidays) and on Saturdays until 12 noon.

### FRESHMAN ADMISSION

The applicant normally should be a graduate of an accredited high school and have the recommendation of the principal. Non-graduates should usually have a high school equivalency certificate, the minimum high school mathematics preparation, and present other evidence of maturity and ability to deal effectively with college work.

Information the University needs for admissions purposes includes: the high school record showing grades through the junior year, a listing of courses in progress in the senior year, a rank in class based on at least three years of high school study, scores on the Scholastic Aptitude Test (SAT), and in some instances the field of study or curriculum preferred.

Applicants *must* have a freshman Predicted Grade Average (PGA) of at least 1.6 in addition to adequate high school preparation in order to be admitted. This PGA is computed using a formula which takes into consideration the student's class rank upon graduation and scores on the SAT (generally the SAT's should be no less than 800). The rank in class carries greater weight in this prediction than do the SAT scores. A 1.6 grade average is the equivalent of a "C"-minus average on a grading scale where a 4.0 is an "A" and a 2.0 is a "C."

Applicants are accepted on either junior or senior year SAT scores, although senior year scores are generally recommended, especially if the applicant is also applying for financial aid. *An interview is not required* and does not weigh in the admissions decision.

North Carolina State University does not have a specific early decision plan for applicants now in high school. All applicants are acted upon as soon as complete admission credentials are received.

### FRESHMAN CLASS PROFILE

Of the freshmen who enrolled in August, 1971, 58 percent ranked in the top

fifth and 88 percent in the top two-fifths. Four percent fell in the bottom half, however, they possessed outstanding SAT scores. The average SAT-Verbal score for this class was 500 and the average SAT-Math score, 564.

## **SCHOLASTIC APTITUDE TEST (SAT)**

Applicants for admission as freshmen must take the College Entrance Examination Board Scholastic Aptitude Test (SAT) and request that their scores be sent directly from the Board to North Carolina State University (Code No.—R5496).

These tests are given several times a year at a number of centers throughout the United States and in foreign countries. Application forms and information booklets may be obtained from your guidance counselor or by writing:

College Entrance Examination Board

Box 592

Princeton, New Jersey 08540

Applications are due in the board office well in advance of the test dates. Prospective students should obtain full information early enough to assure that proper application for the test is made.

## **ACHIEVEMENT TESTS**

The Achievement Tests are not used in the admissions decisions; however, certain of the schools find specific achievement tests helpful for correct placement, and in some cases college credit is given.

Students entering the Schools of Engineering, Forest Resources, Physical and Mathematical Sciences, and the Mathematics and Science Education curricula should take the Math Level I Achievement Test. Those students entering programs in Liberal Arts should take the English and Foreign Language Tests. Those students entering the School of Agriculture and Life Sciences should take the Biology Test, and those entering the Biological Sciences curriculum should also take the Foreign Language Test.

## **ADVANCED PLACEMENT**

Advanced placement is offered to those who are qualified to accelerate their studies. Three means are available for obtaining advanced placement. The student may take a proficiency examination in a subject when he believes that he has mastery of the course material. (Application for such an examination must be made to the head of the department in which the subject is offered.) Secondly, advanced placement and credit is given for satisfactory performance on the subject matter proficiency tests of the College Entrance Examination Board's Advanced Placement Program. Finally, the entering student may be selected for an advanced section in mathematics, a foreign language or history on the basis of his previous academic record and his performance on the College Board aptitude and achievement tests or other examination. In addition, based on a predicted grade in English, a student may be given the opportunity to enroll in English 112, the second semester of freshman English, during his first semester on campus. The PGE (predicted grade in English) is based on the high school record and SAT Verbal score. A "C" or better earned in English 112 would give the student a total of six hours of credit; three hours of credit for English 112 plus three hours of credit for English 111, the first semester course which was bypassed.

## OUT-OF-STATE STUDENTS

Undergraduate applicants from outside North Carolina must generally meet higher standards than required of North Carolina residents before admission will be granted. North Carolina State University is limited to accepting not more than 15 percent of total undergraduate admissions from outside the State.

## TRANSFER STUDENTS

North Carolina State University welcomes transfer applicants. In recent years more than 25 percent of our graduates started their college programs at other institutions.

All transfer applicants must have an overall "C" average on all college-level work taken at accredited institutions and must be eligible to return to the last institution regularly attended. Applications of students from non-accredited institutions will be reviewed by the Admissions Committee.

Work completed at technical institutes is generally not considered college level; after enrolling at North Carolina State University, however, students from such institutes may take comprehensive examinations in courses for which they feel their previous training qualifies them for advanced placement.

Transfer students must present at least 28 semester hours of "C" work or must meet admissions requirements for entering freshmen.

If admitted, the prospective transfer student's record will be further evaluated to determine the amount of credit that can be transferred and applied toward degree requirements at North Carolina State University. This evaluation will be approved by the dean of the school in which the student wishes to enroll. **Transcripts are not evaluated however until the applicant has been admitted.** A nonrefundable \$2 transcript evaluation fee, payable to North Carolina State University, is charged for this service.

## UNCLASSIFIED STUDENTS

An unclassified student is one who has been approved for admission to a specific school and is earning college credit but has not chosen specific curriculum. Unclassified students must meet the same admissions requirements as regular students. If, at a later date, an unclassified student wishes to change to regular status, his credits must be evaluated for his chosen curriculum.

## SPECIAL STUDENTS

The special student classification is primarily designed for students 18 years of age or older who are employed in the Raleigh area, housewives wishing to take courses for self-improvement, and other mature individuals interested in college courses for special reasons but who do not desire to work toward a degree at North Carolina State University. The usual college admissions requirements may be waived for qualified special students, but regular rules of scholarship will apply after admission. A maximum of seven hours per semester may be taken by students in the special classification.

Application as a special student should be made through the Division of Continuing Education, Room 134, 1911 Building. If special students wish to change to regular status at a later date, they must make regular application and meet the same admissions requirements as other degree candidates.

## **AUDITOR**

New students desiring admission as auditors should apply through the Division of Continuing Education. The participation of auditors in class discussion and in examinations is optional with the instructor. Auditors receive no college credit; however, they are expected to attend classes regularly.

## **USAFI CREDITS**

College-level courses offered by accredited institutions and made available to military personnel through the United States Armed Forces Institute will be considered for transfer credit if a grade of "C" or better has been earned and if the courses are applicable to the student's curriculum. A transcript must be sent to the Director of Admissions directly from the institution offering the course.

## **TWO-YEAR AGRICULTURAL INSTITUTE**

Any student who has received a diploma from an accredited high school or has passed the high school equivalency examination administered by the State Department of Public Instruction is eligible for consideration for the Agricultural Institute. Each application must be reviewed and evaluated by the Institute director. The application should include a copy of the applicant's high school record or a letter indicating the applicant has passed the equivalency examination.

Also, the applicant must have a letter of recommendation sent to the Admissions Office by a responsible citizen, not a relative, attesting to the student's integrity and character. The Scholastic Aptitude Test is not required of applicants to the Agricultural Institute.

## **COLLEGE LEVEL EXAMINATION PROGRAM**

The CLEP is designed primarily to serve the non-traditional student who has acquired knowledge through correspondence and University extension courses, educational television, adult education programs, on-the-job training and independent study. It enables adults and unaffiliated students to demonstrate their knowledge and validate their learning by receiving college credit on the basis of examinations, as well as providing measures of college equivalency for use by business, industry, and organizations other than institutions of higher learning.

There are two types of examinations: the General Examinations designed to provide a comprehensive measure of undergraduate achievement in five basic areas of Liberal Arts (English composition, mathematics, natural sciences, humanities, social sciences—history) and the Subject Examinations designed to measure achievement in specified undergraduate courses. The examinations are given at North Carolina State University on the third Saturday of each month, and candidates should register for them three weeks before the test date.

Those interested in further information should write or telephone the North Carolina State University Counseling Center, Box 5505, 210 Peele Hall, Raleigh, N. C. 27607; (919) 755-2424.

## **READMISSION OF FORMER STUDENTS**

To be readmitted after having withdrawn from this University or having been out of school for one or more semesters, the student must be academically

eligible to return and should apply to the Readmissions Office, Department of Registration and Records, 11 Peele Hall, for readmission at least 30 days prior to the date of desired enrollment.

## **GRADUATE STUDENTS**

All students working toward graduate degrees or who are taking courses for graduate credit which are to apply ultimately to a graduate degree are enrolled in the Graduate School. Procedures and policies governing graduate admission are outlined in a special catalog issued by the Graduate School. Any student interested in enrolling for graduate study may obtain a copy of the Graduate School Catalog from:

Dean of the Graduate School  
Peele Hall  
North Carolina State University  
Raleigh, North Carolina 27607

# **Registration**

## **PREREGISTRATION**

Preregistration is a procedure whereby a student meets with his or her adviser to discuss an academic program and to select the courses he or she will take during the next semester. The courses selected by each student are processed through the computer which assigns a day and an hour for each course requested. During the registration period at the beginning of each semester, the student is able to obtain a completed schedule. A Schedule of Courses booklet is available for each student every semester. This booklet contains all necessary instructions for completing preregistration.

## **REGISTRATION**

Registration consists of three steps: (1) paying tuition and fees (preferably by mail), (2) completing registration forms, and (3) obtaining previously prepared class schedules. Students who register late must follow late registration instructions and pay the required late fees. Instructions for completing registration and late registration are issued each semester.

Each student is expected to complete his or her registration *in person*. Under no circumstances is a preregistered student to be considered officially registered until such time as the student has picked up his or her class schedule and completed the registration form.

## **INTERINSTITUTIONAL REGISTRATION**

A regularly enrolled full-time degree student at North Carolina State University may take course work at one of the Raleigh colleges, at the University of North Carolina at Chapel Hill, at the University of North Carolina at Greensboro or at Duke University. Interinstitutional registration form and all registration procedures are available from the Department of Registration and Records.

## **SCHEDULE CHANGES—DROPS AND ADDS**

Courses may be added during the first week of a regular semester; courses may be dropped during the first two weeks of a semester with the result that

they will not appear on the student's record. Beyond this period courses may be dropped as follows:

- 1. During third and fourth weeks, with adviser's approval, a grade of "W" is recorded.
- 2. Thereafter, with the recommendation of the adviser and the approval of the dean, for compelling reason, a grade of "W" is recorded. If the drop is not approved by both adviser and the dean, a grade of "FD" is recorded.

*NOTE:* If a student is enrolled for only one course and wishes to drop it, the procedure is that of withdrawal from the University.

## Tuition and Fees

Charges for tuition and fees vary according to (1) the student's status as a resident or nonresident of North Carolina, (2) the number of hours for which one is registered, (3) the type of student (undergraduate, graduate or part-time). The rate schedule currently in effect is listed below although all charges are subject to change without notice.

### TUITION AND FEES—UNDERGRADUATES—SEMESTER RATE

#### Residents of North Carolina

Hours	Tuition	Required Fees	Total
1-3	\$ 37.50	\$101.00	\$ 138.50
4-6	75.00	101.00	176.00
7 or more	112.50	101.00	213.50

#### Nonresidents

Hours	Tuition	Required Fees	Total
1-3	\$300.00	\$101.00	\$ 401.00
4-6	600.00	101.00	701.00
7 or more	900.00	101.00	1,001.00

*NOTE:* A statement of tuition and fees is mailed to each student four to five weeks before the beginning of each semester. Full payment or complete financial assistance information must be returned with the statement by the indicated due date. The due date is normally one week before classes begin.

### RESIDENCE STATUS FOR TUITION PAYMENT

To qualify for in-state tuition, a legal resident must have maintained his domicile in North Carolina for at least the 12 months next preceding the date of first enrollment or re-enrollment in an institution of higher education in this State. Student status in an institution of higher learning in this State shall not constitute eligibility for residence to qualify said student for in-state tuition.

No person shall lose his in-state resident status by serving in the armed forces outside of the State of North Carolina.

## ESTIMATED ANNUAL UNDERGRADUATE EXPENSES

	First Semester	Second Semester	Year
Tuition: N. C. residents	\$ 112.50	\$ 112.50	\$ 225.00
Out-of-state residents	900.00	900.00	1,800.00
*Other University fees	101.00	101.00	202.00
Room: Men	133.00	133.00	266.00
Women	158.00	158.00	316.00
Board (estimated)	337.50	337.50	675.00
Books and supplies (estimated)	90.00	90.00	180.00
Other personal expenses (estimated)	200.00	200.00	400.00
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Men: N. C. residents	\$ 974.00	\$ 974.00	\$1,948.00
Out-of-state residents	\$1,761.50	\$1,761.50	\$3,523.00
Women: N. C. residents	\$ 999.00	\$ 999.00	1,998.00
Out-of-state residents	\$1,786.50	\$1,786.50	\$3,573.00

**\*Other University Fees.** These fees are for various student services, activities, and building funds. They are turned over in full to the organizations or activities as listed below:

### *Academic Fees:*

Registration, library, classroom and laboratory supplies, and equipment, etc.	\$ 76.00
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### *Nonacademic Fees:*

Medical or Infirmary Fee	20.00
Athletic Fee	20.00
Individual School Fee	4.00
University Center Fee	45.00
University Center Music Wing Fee	9.00
Physical Education and Intramural Athletics	10.50
Gymnasium Building Fee	8.00
Student Government	1.65
Student Publications	7.85

Total	\$202.00
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**NOTE:** All fees are subject to change.

## BOOKS AND SUPPLIES

The cost for books and supplies are variable, depending upon the courses and curriculum in which the student is enrolled. A reasonable estimate is \$180 per year, but students who require drawing supplies and slide rules have an additional original outlay. Books and supplies are purchased directly from the Student Supply Stores.

## GRADUATE STUDENTS

Applicants interested in graduate work may receive a schedule of fees upon application to the Graduate School.

## **PROFESSIONAL STUDENTS**

Students in the various fifth-year professional curricula will be charged on the same basis as undergraduate students.

## **APPLICATION FEE**

A nonrefundable application of \$10 must accompany each application for admission. Transfer students pay \$12; the additional \$2 is a transcript evaluation fee.

## **TUITION ADVANCE DEPOSIT**

Complete information regarding the tuition advance deposit will be included in the acceptance letter.

## **REFUND OF TUITION AND FEES**

A student who withdraws from school on or before the first two weeks of a semester will receive a refund of the full amount paid less an enrollment fee. After that period, refunds may be obtained only by submitting a petition to the Refund of Fees Committee.

## **REFUND OF FEES COMMITTEE**

The Committee endeavors to protect the rights of the student and the University and is empowered to approve a petition when the withdrawal is caused by extensive illness, by military orders, or by other circumstances that justify waiving the rules. The petition forms can be obtained at the Counseling Center, 210 Peele Hall.

# **Financial Aid**

Entering students may gain consideration for all types of assistance by obtaining Parents' Confidential Statement forms from their high schools, having their parents complete the forms and submitting them to the College Scholarship Service in Princeton, New Jersey, preferably before February 1, of the year of expected fall enrollment. The Financial Aid Office at North Carolina State University receives from College Scholarship Service a copy of the Parents' Confidential Statement and a financial need analysis report for each applicant. These data aid in determining the amount of assistance to be offered by the University.

Awards are made to applicants on the basis of financial need, good citizenship and admission to the University. These awards usually offer combinations of scholarship or grant, loan and/or work-study job, depending upon the degree of need.

Upperclassmen must apply for financial aid each year, preferably by February 1. By one application the student receives consideration for all the available types of financial assistance for which he is eligible, including scholarships, loans and work assignments. Continuing students must have a satisfactory record of achievement and citizenship. Aid is made available on a nondiscriminatory basis to all qualifying students.

## **SCHOLARSHIPS**

Scholarship awards are competitive and are given to those applicants

who most nearly meet the selection criteria specified by each scholarship. In addition to the criteria of high academic potential and achievement, good character and financial need, many awards have curricular, geographic or other restrictions or preference specifications.

## **EDUCATIONAL OPPORTUNITY GRANTS**

This federally funded gift assistance is restricted to undergraduate students from low-income families. Annual grants range from \$200 to \$1,500 and can be no more than one-half of the total assistance given to each student. The cumulative amount a student can receive is limited to no more than \$4,000 over a four-year period (or \$5,000 for a five-year baccalaureate program).

## **ATHLETIC AWARDS**

Athletic awards are made upon the recommendation of the Athletic Department to athletes who meet the established qualifications for such awards. A full athletic award provides tuition, fees, room, meals, books and supplies and \$15 per month for laundry and dry cleaning. Awards are available in all sports.

## **NATIONAL STUDENT DEFENSE DIRECT LOANS**

In this federal program students who have been accepted for enrollment or currently enrolled students taking at least half-time course loads and who can demonstrate financial need may borrow a maximum of \$5,000 for undergraduate study, with a limit of \$2,500 during the first two years. Graduate students may borrow up to \$2,500 per year to a maximum of \$10,000 (including undergraduate loans). The repayment and interest period begins nine months after a student ends his studies. The loans bear interest at the rate of three percent per year and the repayment may be extended over a 10-year period, provided the payments are no less than \$15 per month. Preceding graduation or other discontinuation of studies, borrowers in this program are expected to have exit interviews with the loan officer in the Office of Business Affairs to establish a repayment schedule.

Loans on essentially the same terms as the National Student Defense Direct Loan are made from the various University loan funds.

## **GUARANTEED STUDENT LOANS**

Under the Guaranteed Student Loan Program, students are eligible to apply for loans up to \$2,500 for a single year with an aggregate of \$7,500 for undergraduate students and \$10,000 for graduate and professional students (including undergraduate loans). These loans are made by private lenders in the state of the student's residence. Procedures are different in each state. In North Carolina most loans are made through College Foundation, Inc., an agency insured by the State Education Assistance Authority. College Foundation applications and information about loans available to students from other states may be obtained from the Financial Aid Office, 205 Peele Hall.

## **COLLEGE WORK STUDY**

Students from relatively low-income families are eligible for employment by the University in on- and off-campus jobs under federally supported work-study programs. Students may work up to 15 hours weekly while attending classes full-time.

## **PART-TIME EMPLOYMENT**

The Financial Aid Office operates an employment service for all students desiring part-time work while attending school. Jobs are available on and off campus and are not necessarily based on financial need. Placement is usually arranged after the student has his class schedule. Interested students should refer to the list of current job openings available at the Student Employment Office, 205 Peele Hall.

## **EMERGENCY LOANS**

Small short-term loans are available to meet unexpected expenses. These loans must be repaid in 30 to 60 days and are not extended beyond the end of a term or graduation.

# **Student Housing**

North Carolina State University strives to provide suitable accommodations for its students. The University operates 13 residence halls which house 3,958 men, two residence halls which house 800 women, one residence hall which houses 360 men and 456 women, and 300 apartments for married students.

## **RESIDENCE HALLS**

The residence halls are operated to provide opportunities through group living experiences which will complement and expand the educational experiences of the residents. Each hall is staffed with selected students, both graduate and undergraduate, who are responsible directly to professionally trained people in their area and to the Director of Residence Life. The staff members are available to help students initiate programs and activities and to advise and assist residents in any way possible.

The staffs assist the elected officers in each hall to promote a sense of community which is created from the development of cooperation and mutual respect. Residents are encouraged to explore their environment, to take advantage of its many offerings and to initiate, plan, and pursue experimental courses in which they are interested.

Living arrangements in buildings vary. Six high-rise buildings are arranged in suites of four or five rooms sharing a bath; the other buildings have a center corridor with rooms opening on to it. The rooms are furnished but the residents have to provide bed linen, pillows and towels.

## **STUDENT HOUSING POLICY**

Orientation to a university educational environment is an important adjustment for the new student. North Carolina State University recognizes the experience gained from residence hall group living as being of significant value in this personal development of the new student and has, therefore, adopted the following housing policy for both men and women.

Any student who has carried less than 28 hours (passed or failed at North Carolina State University or any other college or university) must reside in University housing unless (1) married and living locally with spouse, (2) living with parent or married member of his or her immediate family, or (3) veteran (at least two years of active military service). Students who qualify under one of the above exemptions must obtain written permission from the Director

of Residence Facilities to live outside University housing.

If a single undergraduate student who has carried 28 hours or more does not arrange for University housing, this will be the student's certification to the University that he or she has obtained parental permission to live outside University housing.

To be eligible for University housing one must enroll as a regular full-time student (an undergraduate must roster a minimum of 12 credit hours per semester).

## **ROOM RENTALS AND RESERVATIONS**

Rooms in the men's residence hall rent for \$133 per semester and in the women's hall for \$158 per semester. Reservation cards are mailed with the letter of acceptance for admission to the University. These reservation cards and the check for the rent must be returned to the Office of Business Affairs in accordance with the dates established by the Housing Rental Office before room assignments can be made.

## **REFUND OF ROOM RENT**

If a room reservation is cancelled at the Housing Rental Office, Leazar Hall, in person or in writing on or before August 15th for fall semester and December 15th for spring semester (the date of cancellation is the date notification is received by that office), the rent paid will be refunded less a \$25 reservation fee, which is nonrefundable if a student is eligible to register. Between August 15th (for fall semester) and the last day to withdraw with tuition refund, and between December 15th (for spring semester) and the last day to withdraw with tuition refund, no refund will be made for any reason other than failure to register or official withdrawal from the University. During these times and for the above stated reasons, the rent paid will be refunded less the \$25 reservation fee and a daily charge of \$2 from the first day of classes until the room is vacated. Students who fail to notify the Housing Rental Office and who fail to check in and secure their keys on or before 5 p.m. the first day of classes will have their reservation cancelled without refund.

## **HOUSING FOR MARRIED STUDENTS**

The University operates 300 apartments (McKimmon Village) for married students. The rental is \$50.50 for an efficiency; \$61.00 for a one-bedroom; and \$72.50 for a two-bedroom, including water only (gas is included in efficiency units). Priority in renting goes to graduate students. Information on availability and applications should be requested from the Housing Rental Office, North Carolina State University, Box 5505, Raleigh, N. C. 27607.

Raleigh has numerous privately owned apartments and houses available for rent to university students. A partial listing is located in the Housing Rental Office. No listing is published because of the rapid turnover.

The University does not operate a trailer parking area; however, privately owned parks are available within a reasonable distance of the campus.

## **FRATERNITIES**

Seventeen of the 18 social fraternities chartered by the University maintain a chapter house. Twelve of the houses are located on Fraternity Row, a University owned project; the remaining five are located throughout the immediate community. Presently plans are being made for construction of two sorority

houses on Fraternity Row. Fraternities are under the University's supervision and are required to have a resident housemother or chapter resident adviser who serves in a wide variety of ways.

Rental fees vary in fraternity houses depending upon the individual chapter, but are approximately the same as the residence hall rates.

*Forest Resources undergraduates receive instruction in this specialized laboratory on the testing of tear strength of experimental papers.*



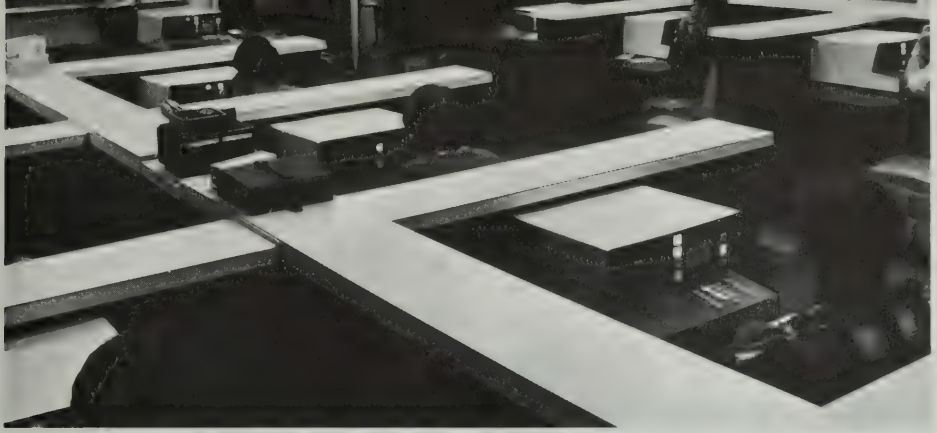


*Geosciences offers training in physical and engineering sciences as well as geology training in areas pertinent to human affairs.*

*Food Science students apply physical and biological sciences, engineering and economics to food development, processing, packaging, quality control, distribution and utilization.*

*Front entrance to new University Student Center.*





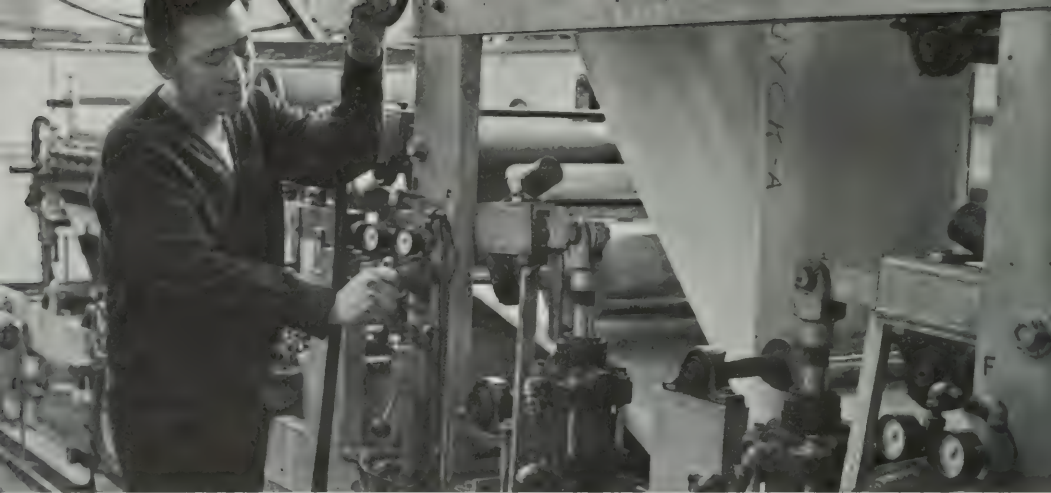
*All freshmen engineering majors take this Analog Hybrid Terminal laboratory to become acquainted with computerized problem solving.*



*Laboratory work gives practical experience to students studying industrial arts education.*



*View of the Coliseum and the University Student Center looking from the Students Supply Store.*



*Pulp and water become paper in the laboratories of the School of Forest Resources.*



*University residence halls.*



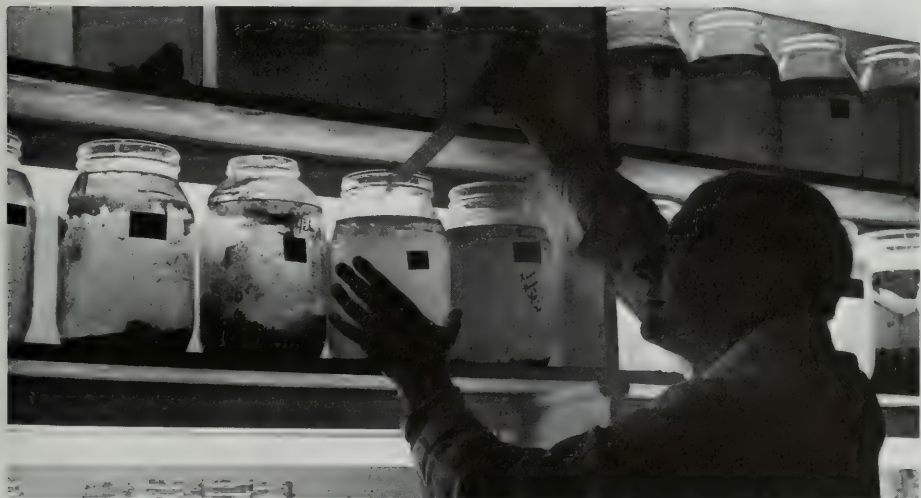
*Textiles students are concerned with industrial processes that constitute the final steps in the preparation of textile materials for the consumer.*



*New PULSTAR reactor in Nuclear Engineering.*



*Plasma physics students investigate behavior of charged particle beams.*



*The effects of space on living organisms is studied in this genetics lab.*



*The University Plaza at night.*



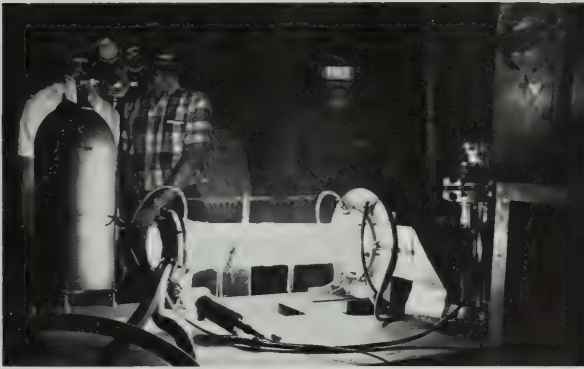
*Study areas in the air-conditioned D.H. Hill Library provide comfortable surroundings for the student.*

*"All-Campus Weekend," each spring, is a welcome break from studies enjoyed by students.*





*Playing chess is just one of many extra curricular activities enjoyed by NCSU students.*



*Plasma physics students utilize the "linear pinch."*

*Twelve national social fraternities maintain houses in a fraternity court near the campus. All houses are under University supervision and have a resident housemother or chapter resident adviser.*



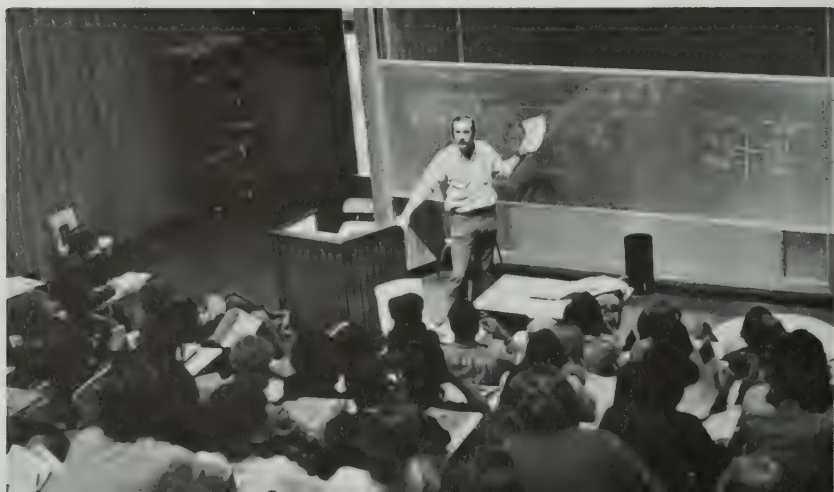


*Marine Science students work at laboratories on the North Carolina coast.*

*The School of Engineering prepares students for entry into the fields of design, development, production, sales, application, and planning or operation of industrial units, as well as for advanced study in a specialized engineering branch.*



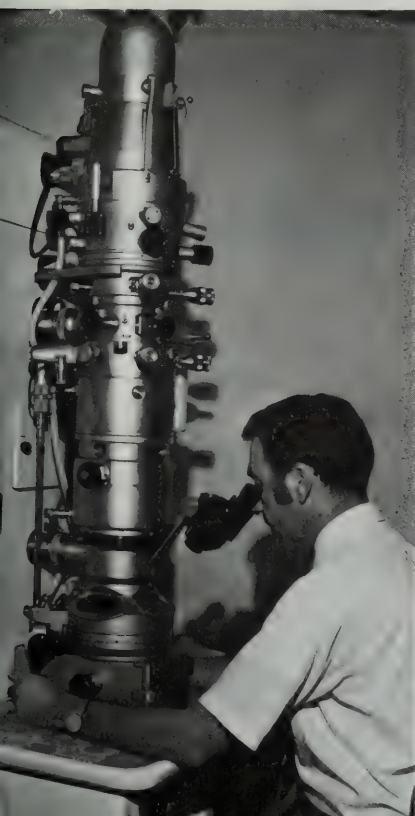
*One of the many large lecture rooms on the NCSU campus.*





*Outdoor eating facilities are available at several locations on campus.*

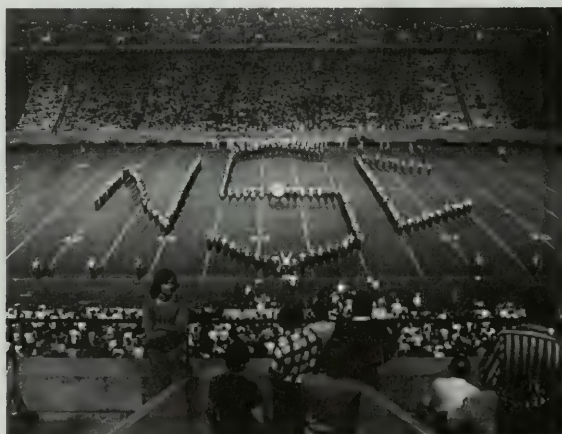
*Electron microscopes are used in teaching and research in agricultural and life sciences.*



*Research in a history course lead to the creation of this dress and pie based on patterns and recipes of the days of Henry VIII.*



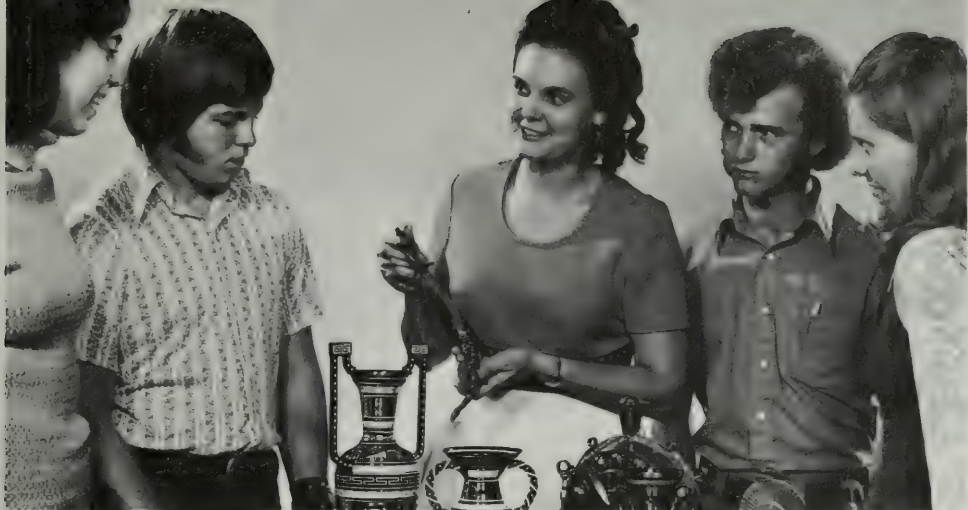
*William Neal Reynolds Coliseum.*



*The NCSU marching band performs at all home football games.*

*The greenhouse range constitutes a valuable research and education complex.*





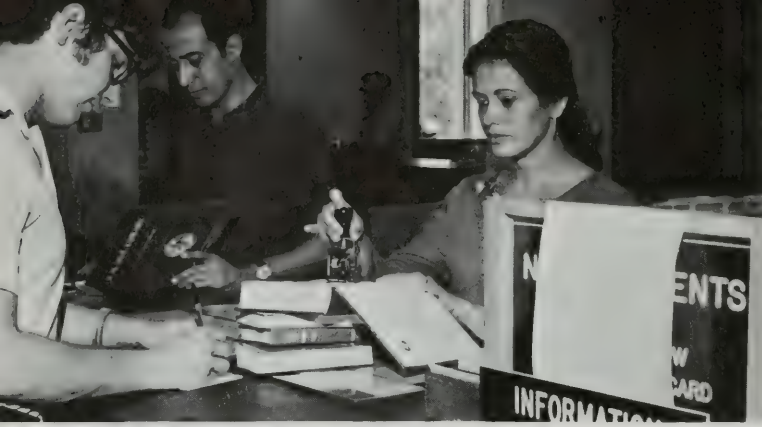
*An English professor involved in a research project on ancient Greece displays replicas of vase paintings and weaponry.*



*Cox Hall, headquarters for the School of Physical and Mathematical Sciences.*



*The campus craft shop provides instruction and facilities for development of skills ranging from ceramics and weaving to photography and woodworking.*



*Check-out desk at D.H. Hill Library.*



*Typical campus scene in the residence hall area.*

*The University Student Center has several different types of eating facilities.*



# Academic Regulations

## QUALITY POINTS AND GRADE POINT AVERAGE

North Carolina State University uses a system of credit hours, letter grades and quality points. The semester credit hours represent the amount of work completed, the letter grades indicate the quality of the student's work, and the quality points provide a means of converting letter grades to numerical averages. Four quality points are earned by undergraduate students for each hour of A; three for B; two for C; one for D; and none for F. For example, a grade of B in a three credit hour course would earn nine quality points for that course.

The grade-point average is obtained by dividing the total number of quality-points earned at NCSU (plus any earned at another campus of the statewide University of North Carolina system)\* by the number of credit hours carried for quality points (passed plus failed). Credit hours transferred from other colleges and universities, obtained by proficiency examination, or earned in certain programs or credit-only courses do not enter into the computation of the grade-point average.

\* Subject to change by the Board of Governors of the University of North Carolina system.

## DEFINITION OF LETTER GRADES AND QUALITY POINT VALUES

Grade		Quality Points Per Credit Hour
A	Excellent	4
B	Good	3
C	Satisfactory	2
D	Poor	1
F	Unacceptable	0
FA	Unacceptable (Did not attend examination)	0
FD	Unacceptable (Dropped course)	0
FI	Unacceptable (Failed to remove incomplete)	0
S	Satisfactory	0
U	Unsatisfactory	0
CR	Passing grade for credit-only course	0
NC	No credit: Failing grade for credit-only course	0

Neither quality points nor credit hours are given for the following grades: W—Withdrew with passing grade, IN—Incomplete (temporary), LA—Later (temporary), AB—Excused from final examination (temporary), AU—Audit, NG—Poor Attendance (AU grade not given).

At the discretion of the professor, a student may be given an incomplete (IN) grade for work not completed because of a serious interruption in his work not caused by his own negligence. An incomplete must be made up by the end of the next regular semester (not including summer sessions) the student is in residence unless the department involved is not able to allow the make-up. In the latter case, the department will notify the student and the Department of Registration and Records when the IN must be made up. *The student must not register again for the course while the IN stands.* Any incomplete not removed during either the period specified by the department or the next regular semester in residence will automatically become a failure and will be recorded as FI except in the case of a graduating senior who does not need the

course to meet a graduation requirement; in this instance the Incomplete (IN) will be changed to a W by the school dean or director of instruction.

A grade of FA is recorded for an unexcused absence from a final examination. If an absence from the examination is excused, a grade of AB is recorded, and the student must arrange to take the examination during the next regular semester (not including summer session) he is in residence, or the final grade becomes FA. *The student must not register again for the course while the AB stands.*

The grade of FD is recorded if a student has unofficially dropped a course for which he had been scheduled or if he has officially dropped it with a failure. A failure may be made up only by repeating the subject. Such a repeat course must be regularly scheduled on the student's class schedule.

In the case of a graduating student who has received an AB (absent from examination) or an IN (incomplete), the following procedures will apply:

1. If the course *is not* needed to meet a graduation requirement (course, total credit hour, or 2.0) the AB or IN will be changed to a W by the school dean or director of instruction.
2. If the course *is* needed for graduation, the student will not be allowed to graduate until the work has been made up.

## GRADE REPORTS

At registration, students will be asked to complete an address card which will be used to mail grade reports and other routine correspondence. Many student grade reports go to the students' parents or guardians. However, many students, because of age or marital status, elect to have their grade reports sent directly to themselves.

## ACADEMIC RETENTION-SUSPENSION RULES

An *undergraduate* student whose cumulative grade-point average is 26 or more quality points below the 2.0 level required for graduation in all undergraduate curricula is suspended and is ineligible to continue for the next regular semester unless he is eligible to continue under the Semester 2.0 Continuation Rule.

For a student who has been readmitted by the Admissions Committee or who was eligible to continue under the sliding scale requirement that was in effect prior to the constant quality point deficit system, the Semester 2.0 Continuation Rule permits a student whose deficit is greater than 25 quality points but who has made at least a 2.0 average for his most recent regular semester (regardless of the number of hours he has carried during that semester) to continue on Provisional Status.

A student can lose his eligibility to continue under the Semester 2.0 Continuation Rule if he attends summer school and earns less than a 2.0 in *either* summer session. Such an increase in his overall quality point deficit puts him into Suspended status. Thus, he will not be eligible to register for a regular semester (1) unless he is approved by the admissions committee or (2) until by correspondence course work and/or subsequent summer session work he reduces his quality-point-deficiency to 25 quality points or less.

A suspended student may appeal to the Admissions Committee for special consideration of extenuating circumstances. A letter of petition should be written by the student to the Admissions Committee stating:

1. the reason for one's academic difficulty
2. the reason why one believes he or she can now be successful in meeting the University's academic standards.

## **REPEATING COURSES**

A student who repeats a course previously taken (passed or failed) will have both grades counted in his cumulative grade-point average. An undergraduate student may be allowed as many semester hours as are appropriate in one's curriculum for courses that : (1) are titled seminar, special problems, special topics, independent study or research; such courses are usually numbered 490-499 or 590-599 and (2) cover topics different from those studied when the courses were taken previously. However, for any courses other than one that satisfies these conditions, if a student repeats and passes the course both times, the semester hours will be counted only once toward the number of hours required for graduation.

The adviser's approval is required for a student to repeat any course previously passed. Such approval should not be given when a student wishes to repeat a course which he or she has already passed with a grade of A or B. Nor should it be given when: (1) a student wishes to repeat a lower division course that he or she has passed with a grade of C or better after having successfully completed an advanced course covering the same material or (2) a student wishes to repeat a lower level course that one has passed with a C or better which is a prerequisite for an advanced course that one had already successfully completed.

## **CREDIT-ONLY COURSES**

Each undergraduate student will have the option to count toward graduation requirements a maximum of 12 semester hours in the category of "credit-only" courses (exclusive of courses which departments or instructors choose to grade on a Satisfactory-Unsatisfactory basis with the approval of the Provost's Office). The student may select as "credit-only" any course offered by the University except the several courses in Military Science and Aerospace Studies. The selected courses must be included under the free elective category of the specific curriculum in which the student is enrolled. He will be placed in a regular section and will be responsible for attendance, assignments, and examinations.

The student's performance in a "credit-only" course will be reported as CR (passing grade for credit-only course) or NC (no credit: failing grade for credit-only course) and will not affect his grade point average. A passing grade (CR) will allow the course credit to be counted toward the student's graduation requirements. D-level work (passing work) is considered an adequate basis for awarding credit (CR) if the instructor is otherwise satisfied with the student's class participation, attitude, and attendance. A student should be made aware that "credit-only" work may drop him below 12 hours of course work for which quality points are earned and thus make him ineligible for Semester Dean's List.

## **WITHDRAWAL FROM THE UNIVERSITY**

If a regularly enrolled student wishes to withdraw from the University (dropping all courses) during a semester or summer session, he must go to the Counseling Center to initiate the official withdrawal process.

Determination of grades and the entry on the permanent record for a student withdrawing during a semester depend upon his reasons for withdrawal, the time of withdrawal in the semester, and his standing in his courses at the time of withdrawal. A student who discontinues attendance in all classes without officially withdrawing will receive all "FD" grades.

A student who withdraws after the first two weeks of classes will not receive any refund of tuition and fees, except in unusual cases approved by the Refund Committee.

Withdrawal constitutes a break in the student's residence, and, if the student plans to return, he must file a readmission form even though he may have pre-registered for the next academic period.

## **OPPORTUNITIES FOR SUPERIOR STUDENTS**

Several schools encourage talented students by providing opportunities for **selected** upperclassmen to pursue independent study and original work. The Schools of Agriculture and Life Sciences, Engineering, Forest Resources and Physical and Mathematical Sciences have organized programs to include several possibilities as honors courses, undergraduate research and seminars. Potential participants are identified through advanced placement, academic performance, and faculty recommendation. There are also optional programs of advanced level work offered by the Departments of History, Mathematics, Modern Language and Physics.

Information is available from faculty advisers, teaching departments and the office of the dean of each school.

## **CHANGE OF NAME OR ADDRESS**

It is the student's responsibility to inform the Department of Registration and Records of any changes in name or address. Failure to do this may cause delay in the handling of the student's records.

## **AUDITS**

A student wishing to audit a course must have the approval of his adviser and of the department offering the course. The participation of auditors in class discussion and in examinations is optional with the instructor. Auditors receive no credit; however, they are expected to attend classes regularly.

A student who has taken a course for audit may, with his adviser's approval, enroll in the course for credit during the subsequent semester or summer session.

## **REEXAMINATIONS**

Any student who fails a course within two semesters of graduation and who fails only one course during that semester may apply to the Department of Registration and Records for permission to remove that failure by taking a reexamination on the total subject matter of the course. For this regulation, summer school counts as a semester. If he fails that reexamination, he is not eligible for another reexamination in that course. If he fails more than one course during the next to the last semester, he cannot take a reexamination that semester; but if he subsequently removes all but one of these deficiencies by repeating the course or courses, has had no other reexamination, and has completed all other degree requirements, he may apply at the end of his last semester in residence for permission to take a reexamination.

Eligibility to take a reexamination will be determined by the Department of Registration and Records. When such a reexamination is taken to remove an F, only the reexamination grade will be counted. A senior who has passed a reexamination will have his grade for that course changed from F to D,

which will affect his cumulative grade-point average. A fee of \$5 is charged for administering such a reexamination. If a student takes a reexamination, fails it, and subsequently audits the course, he cannot take another reexamination, but may apply for credit by examination, which carries no grade.

## **SEMESTER COURSE LOAD AND SPECIAL REQUIREMENTS**

The University considers a minimum full-time semester load as 12 credit hours for undergraduates and nine credit hours for graduate students. The maximum load for a semester is 21 credit hours for undergraduates and 15 credit hours for graduate students. To carry more than the maximum, a student must consult with his adviser and obtain the approval of his dean or director of instruction. Permission is granted only under extenuating circumstances.

For a regular summer session, a student must have the same approval if he carries more than seven credit hours.

A student whose deficiency is one through 25 quality points will be placed on *Provisional Status* and will be responsible for seeing his adviser for approval if he has scheduled more than 15 credit hours for a regular semester.

To be eligible to live in a residence hall or a fraternity house, an undergraduate student must carry at least a 12-hour load during a regular semester.

*Freshmen English*—English 111 and 112 are required in all curricula and must be scheduled in successive semesters until they are completed satisfactorily. Students must earn a grade of C or better in one of the two courses. Those students who qualify for advanced placement on the basis of previous academic record and performance on the College Board Scholastic Aptitude Test will be given opportunity to enroll in English 112H. If such students earn a grade of C or better in the course, six hours of credit (three "by examination") will be allowed, covering both courses. The Writing Laboratory (ENG 200) may not be used to satisfy the freshman English requirement.

*Physical Education Requirements*—Physical education shall be required of undergraduate students. The duration of required participation shall vary from a minimum of one year (two semesters) to a maximum of two years (four semesters) depending upon the needs, interests and abilities of the individual students. The duration of the requirement shall be determined by the Department of Physical Education. Exceptions to the physical education requirement are granted on the basis of the university physician's recommendation.

## **CREDIT BY EXAMINATION**

A currently registered undergraduate student (degree, unclassified or special) desiring to take an examination for course credit in lieu of enrolling or reenrolling for the course must initiate the request with his adviser (except when a teaching department initiates group testing of beginning students for placement purposes and grants credit). Should the adviser approve, the student must arrange for the examination with the department offering the course. The department may administer the examination in any manner pertinent to the materials of the course. The academic standards for credit by examination will be commensurate with the academic standards for the course.

If the student exhibits satisfactory performance on the examination, the

instructor will notify the Department of Registration and Records on a late grade report form (pink) by stating, "Credit by Examination". The Department of Registration and Records will enter the appropriate number of credit hours on the student's permanent record and will issue a grade report as for courses taken in residence. Credits earned in this manner are considered in the same way as transfer credits and are not used in the computation of the student's grade-point average. If the student fails, no action beyond notifying the student is required. The Department of Registration and Records will post course credit to the permanent record only if the student is currently registered.

## READMISSION OF FORMER AND SUSPENDED STUDENTS

A *former student returning* is one who (a) was not in attendance during the fall or spring semester prior to applying for readmission or (b) withdrew from the University during a fall or spring semester or during a summer session. All former students returning, both graduates and undergraduates, must apply for readmission. A student who receives a bachelor's degree must apply for admission to the Graduate School or for readmission as an undergraduate working toward a second bachelor's degree, unclassified, or professional. Preregistration alone is not sufficient to enable the student to be readmitted.

### *Regulations:*

1. A student who was eligible to continue at NCSU at the time of his leaving is eligible to return even though his quality-point deficit exceeds the maximum of 25 [except as indicated in (a) or (b) immediately below]. Students in this category need only complete a readmission form.
  - a. A student who was eligible to continue at the time of his leaving but who has subsequently taken work at another institution and earned less than a C average on such work must complete a readmission form and write a letter of petition to the Admissions Committee.
  - b. A student eligible to continue at the time of his leaving who has subsequently taken correspondence and/or extension work at NCSU or course work at another campus of the statewide University of North Carolina system\* and earned grades which resulted in suspension must complete a readmission form and write a letter of petition to the Admissions Committee.

\* Subject to change by the Board of Governors of the University of North Carolina System.

2. *Suspended Students.* A suspended student is eligible to attend summer school at North Carolina State University and take approved correspondence courses to improve his academic standing and will be eligible for readmission when he reduces his quality point deficit to 25 or less. There is no limit on the number of summer school periods open to a student who is trying to earn readmission. A student who was suspended under former retention-suspension regulations but whose overall deficiency is less than 25 quality points is eligible for readmission provided he has not subsequently taken work at another institution and earned less than a C average on such work.

A student who was suspended under the now discontinued Semester

Rule, but who otherwise was eligible to continue at the time of his leaving, need only complete a readmission form.

A student who was and continues to be suspended for academic deficiencies and who desires to return cannot be readmitted unless approved by the Admissions Committee. Each should write a letter of petition to the Admissions Committee stating:

- a. the reasons for academic difficulty;
- b. why he believes he can now be successful in meeting the University's academic standards and complete all degree requirements within a reasonable length of time; and
- c. the address to which he wishes the Committee's decision sent.

## DEAN'S LIST

A full-time undergraduate student who earns a semester average of 3.0 or better on 12 or more hours of course work for which quality points are earned is placed on the Semester Dean's List. This achievement is noted on the student's grade report and permanent academic record. Also, news stories on the Semester Dean's List are distributed to hometown newspapers.

## CLASSIFICATION OF STUDENTS

Students are classified at the beginning of each regular semester and summer session. The required number of hours of each classification is as follows:

<i>Classification</i>	<i>Semester Hours of Earned Credit</i>
Freshman (FR)	Less than 28
Sophomore (SO)	28 or more, but less than 60
Junior (JR)	60 or more, but less than 92
Senior (SR)	92 or more
Fifth Year (School of Design) (05)	134 or more

Agricultural Institute students are designated as first (01) and second (02) year students. Until an Agricultural Institute student has received a total of 28 semester credits, he is classified as a first year student.

*Unclassified* students are those who are working for college credit, but who are not enrolled in a degree-granting program. Admission as an unclassified student requires the recommendation of the dean of the school in which the student wishes to enroll. Unclassified students must meet the same entrance requirements as regular students and must meet the same entrance requirements to continue.

Special undergraduate students in the various schools are non-degree candidates carrying seven hours (two courses) or less in a semester. Special undergraduates must meet the same academic requirements as regular students in order to continue during a regular semester. Special students on the graduate level are non-degree candidates who may not earn more than six hours in this classification.

## TRANSCRIPTS OF ACADEMIC RECORD

A transcript is an exact copy of a student's permanent academic record at the time it is issued. Each student is entitled to one free official transcript of his record. After the free copy, a fee of one dollar will be charged for each transcript. If a transcript is requested during a semester and a supplemental copy is needed after semester grades are posted, both original and supple-

mental copies are subject to the fee of one dollar each.

No official transcript may be issued to or for a student who is indebted to the University until such indebtedness has been paid or satisfactorily adjusted.

## **CURRICULUM CHANGE**

In initiating a curriculum change, a student must secure a Curriculum Change Form from the office of his dean or director of instruction, obtain the required signatures, and file the completed form with the Department of Registration and Records, desirably by the end of the preregistration period.

Although the Department of Registration and Records will not change the records until the student registers for a new semester or summer session, from the standpoint of advising, preregistration, and dropping courses, the student is considered to be in the new curriculum as soon as the Curriculum Change Form is completed and filed with the Department of Registration and Records, and his records are transferred to his new department.

## **GRADUATION REQUIREMENTS**

A student is scholastically eligible for graduation when he has satisfied all the specific requirements of his department, his school and the University and has earned at least a 2.0 cumulative average.

Individual departments and/or schools may determine their own limits, if any, of credit hours for off-campus classes and/or correspondence courses.

A transfer student, to be eligible for a bachelor's degree, normally must earn at least 24 of his last 30 hours of credit in residence on this campus; however, individual departments and/or schools may waive this guideline and determine their own residency requirements for a bachelor's degree. Each department and/or school shall establish its own regulation.

To be graduated with honors or high honors, a student must have attained a 3.0 or a 3.5 grade point average respectively on all semester hours of work considered in computing his average.

Students who have satisfactorily completed the requirements for more than one bachelor's degree may, upon the recommendation of their deans, be awarded two bachelor's degrees at the same or at different commencement exercises. To earn two degrees the student registers in one school or department and, with the cooperation of the second school or department, works out his program to cover the requirements for both. The student must file an approved Curriculum Change form labeled "Second Degree" with the Department of Registration and Records.

Presence at graduation exercises is required except when permission for graduation in absentia is granted. Forms for requesting such permission are available from the Department of Registration and Records.

Students anticipating graduating must file a "Diploma Blank" with the Department of Registration and Records the semester prior to such anticipated graduation. Diploma blanks are available in any academic departmental office or in the Department of Registration and Records.

## **The D. H. Hill Library**

Library facilities at North Carolina State University include the main D. H. Hill Library and special libraries for the Schools of Design and Tex-

tiles. The collections, totaling more than 600,000 volumes, have been carefully assembled to serve the educational and research programs of the University.

The D. H. Hill Library contains particularly strong research holdings in the biological and physical sciences, in all fields of engineering, agriculture and forestry. The 6,000 volume Friedrich F. Tippmann collection in the field of entomology and related biological sciences is one of the outstanding collections in the country. The collection of books and journals in the humanities and social sciences is especially helpful to undergraduate students.

The library's comprehensive collection of scientific journals emphasizes the major teaching and research interests at NCSU; approximately 6,700 journals are received regularly. A large collection of state and federal government publications further strengthens the library's research material. The D. H. Hill Library is a depository for publications of the Atomic Energy Commission and the Food and Agricultural Organization of the United Nations, and has been a depository for U. S. federal documents since 1923.

The Textiles Library, located in Nelson Textile Building, contains outstanding holdings in the field of textiles and textile chemistry. It is regarded as one of the best textile libraries in the country. The School of Design Library, in Brooks Hall, has a very fine collection of books, journals and slides in the areas of architecture, landscape architecture and product design.

As a further aid to graduate and faculty research, the library participates in an interlibrary loan program with the University of North Carolina at Chapel Hill, Duke University, Research Triangle Institute, IBM, Chemstrand, the Division of Environmental Health Services and the N. C. State Library in downtown Raleigh. A bus, arriving at North Carolina State University daily Monday through Friday, makes resources from these seven libraries available to NCSU students and faculty. Among the materials available are approximately 14,000 scientific periodicals.

The D. H. Hill Library building has been expanded recently for additional library seating and open shelf collections. The building includes an 11-story addition and the addition of the Erdahl-Cloyd Wing for undergraduate services. The East Wing is the Reference-Research component of the Library and houses the card catalogs, the general reference department, the extensive U. S. documents collection and the library's extensive collection of current periodicals. The enlarged library complex provides bookstacks for over 1,000,000 volumes and greatly expanded research facilities, including carrels and study areas.

Among the many services offered by the library are orientation tours for faculty and graduate students, and also lectures on library use to all new students. Comprehensive reference service is available almost all the hours the library is open. The microform reading room houses a variety of microtext readers and printers in the library and an extensive microfilm collection provides access to much important research material. Facilities for listening to taped recordings are available. One of the most widely used services in the library is the photocopy service. Coin-operated machines plus two machines operated by staff, provide a wide variety of photocopy service, including copy from microfilm. Machines may be used all hours the library is open.

# **General Information**

## **LAUNDRY**

The University operates a modern laundry and dry cleaning facility on campus at reasonable prices. Branch offices are located in the residence halls for the convenience of the students.

## **LINEN AND BLANKET RENTAL**

The linen service provides for the initial issues of two sheets, one pillow case and three towels. The student may exchange his linen weekly at a cost of \$28 per year. Pillows may be rented for \$1.50 per year. A regular blanket rents for \$3 per year, and the N. C. State monogrammed blanket rents for \$6.50. These services are available to both on- and off-campus students. Application forms for these services will be mailed to each student.

Refunds under the linen rental plan are computed on a semester basis. During a semester, refunds will be computed at a charge rate of 70 cents for each week the plan has been in use, plus a \$3 service charge until \$14 is exhausted. Refunds are not available for the weeks a student fails to exchange linen.

## **FOOD SERVICE**

Food service is provided in Harris Cafeteria, the University Student Center, the University Student Center Annex and six snack bars on campus.

Cost depends on the individual's requirements and the selection of food and could vary from \$600 to \$700 for the academic year. A Dining Club Plan is available in Harris Cafeteria at a reduction of approximately 10 percent from cash prices. Information concerning the Club Plan is furnished all regularly enrolled students prior to each fall semester.

## **AUTOMOBILES**

Only those freshmen who are married and residing locally with spouses, those living in homes of parents or those physically handicapped will be permitted to register or park a four-wheeled motor vehicle on the University campus at any time. Each freshman is reminded that giving any false information regarding registration of motor vehicles or allowing another student to register a vehicle for him will be a direct violation of the Honor Code.

For the purpose of traffic rules and regulations, the campus is defined to include all University property adjoining or contiguous to the main campus (McKimmon Village and Fraternity Court included).

## **CAREER PLANNING AND PLACEMENT CENTER**

The Career Planning and Placement Center offers assistance to all students at North Carolina State University at all degree levels, and this service is available on a year round basis. Advice on the relationship of personal career goals to various programs of study and assistance in the identification of individual aptitudes and abilities affecting career potential are available to students. Aptitude and interest testing is a service provided by the Counseling Center to which students are often referred in the initial stages of their career planning. Students are urged to take advantage of the career planning service in the early years on campus in order to identify their

career potential and to make optimum educational decisions.

In addition, this office arranges and coordinates job interviews between students and employer representatives. In their senior year students are urged to use this placement service for interviewing with potential employers. The staff will also recommend contacts with employers not scheduled to visit the campus, and will advise students of job opportunities given to the center by mail or telephone.

Representatives of business, industry, government and education come from throughout the country to interview North Carolina State University students. Typically about 800 employers will conduct approximately 10,000 interviews a year on campus, with additional numbers of employers advising of career potential by mail or phone.

Career Planning and Placement Center personnel provide individual and group career advisory programs on job and graduate school opportunities and placement in general. Other functions of the center include helping students find summer work and temporary or part-time jobs related to their field of study, and assisting alumni with career adjustments.

In addition to its responsibilities to students, the center serves as a connecting link between the University and the business and industrial community with the further responsibility of keeping the faculty and administration informed of employment trends.

## HEALTH

North Carolina State University seeks to safeguard the health of the student in every way possible. The University maintains a 64-bed infirmary which is open 24 hours a day. The infirmary is fully staffed by physicians, nurses and auxiliary personnel. Among the valuable features of the infirmary are an up-to-date first-aid department and an X-ray department.

The University physicians observe daily office hours at the infirmary in the mornings and afternoons. In addition, they visit the infirmary more often when necessary. A graduate nurse is on duty day and night. Students have free access to the infirmary at all times except when closed during holiday periods.

In case of accident or the serious illness of a student, parents or guardians will be notified immediately. No surgical operation will be performed without full consent of parents or guardians, except in cases of extreme emergency.

The medical fee paid by each student provides for infirmary service, general medical treatment and the services of nurses. It does not provide for surgical operations, outside hospital care, or the services of dentists or other specialists. Special students and others who have not paid the health fee are not entitled to the services of the Student Health Service.

Before the student enters North Carolina State University, he should have a complete, thorough examination by his family physician. Any abnormality should be noted and all defects corrected in order to prevent unnecessary loss of time while the student is in college. If the examination is not made before he enters, the student will be given a physical examination at the University, for which a fee is charged. Blanks for the physical examination may be secured from the Office of Admissions. Physical examinations for entrance into the University, for job application, marriage, food handlers, military, passport, etc., will be given at the convenience of the Director of the Health Service and at an extra fee.

The infirmary does not offer its services to dependents of students. Mar-

ried students are encouraged to enroll in the Student Government Health and Accident Insurance Group Policy which covers dependents.

## **ACCIDENT AND HEALTH INSURANCE**

The University offers annually a plan of student accident and health insurance. The insurance is planned to cover the surgical, accident, and hospital needs of the student, as a supplement to the services offered through the infirmary. Each year complete information will be made available to students before the opening of school.

Foreign students are required to enroll in the sickness and accident insurance plan provided through the University or to have similar coverage under other insurance plans or arrangements with their sponsors.

## **ORIENTATION**

The University sponsors a Summer Orientation Program for all new students. Anyone who, because of extreme hardship, finds that he or she is unable to attend the summer program may request permission to attend late orientation during the week preceeding the opening of school.

The orientation program is designed to acquaint new students with the academic, extracurricular and social life at North Carolina State University. A planned series of meetings and conferences with faculty and student leaders gives newcomers to the campus the information needed to get their college careers underway.

## **COUNSELING**

The Counseling Center in Peele Hall has a staff of counselors to help students with the problems of adjustment to college life, problems of vocational and curricular choice and any other problems a student might wish to discuss. The center administers aptitude and interest tests and maintains a file of occupational information to help guide students in career selection.

The center also offers psychiatric evaluation service and marriage counseling, provided by part-time specialists who augment the center staff. Center staff members offer personal adjustment counseling, group counseling and self-development workshops.

Students may come to the center on their own accord, or they may be referred by teachers, advisers or other members of the University staff. There is no charge for conferences, but a small materials fee is charged when tests are administered.

## **FOREIGN STUDENT ADVISER**

A foreign student adviser, as a part of the Counseling Center in 213 Peele Hall, offers counseling and guidance services to all foreign students. Foreign students and faculty may obtain help with visas, passports, currency permits, tax information, and medical, personal and social problems.

International Student Orientation (ISO 100), a one-hour course given in the fall semester, is required of all foreign students to acquaint them with university procedures, government regulations, and practical problems of life in Raleigh. Subjects covered include university services, immigration regulations, health and automobile insurance, drivers license requirements, employment, taxes and consumer problems.

Study Opportunities Abroad and Foreign Travel information is available

to all students from their foreign student adviser. A file on world-wide study opportunities is maintained in that office. Rhodes, Marshall, Fulbright Scholarships and foreign travel information is also available. International Student Identity Cards may be purchased by qualifying full-time students.

## **FACULTY ADVISERS**

When a student enrolls at North Carolina State University, he or she is assigned a faculty adviser who is usually a member of the department in which the student will be taking major work. The adviser: (a) provides information, advice, and recommendations in academic and related areas, (b) directs the student to sources which explain in detail academic regulations, course prerequisites and graduation requirements, (c) helps the new student to understand the degree to which one should assume responsibility for one's own program planning, (d) provides vocational guidance and occupational information in one's area of specialty, and (e) refers the student to the appropriate individual, office or agency when further assistance is indicated.

Deans, directors of instruction and department heads are also available to students wanting information about different curricula and help in forming educational plans. Instructors are usually the best source of help to students having difficulty with particular subjects. Members of the faculty keep office hours and expect students to consult them individually whenever special assistance is needed.

## **COOPERATING RALEIGH COLLEGES**

The Cooperating Raleigh Colleges is a voluntary organization comprised of North Carolina State University, Meredith College, Peace College, St. Augustine's College, St. Mary's Junior College and Shaw University. The organization's purpose is to develop and conduct cooperative educational activities. The organization provides the opportunity for any student to enroll at another institution for a course or courses not offered on his home campus. Other activities include a cooperative library arrangement, joint student activities and faculty cooperation and interchange.

## **Student Activities**

North Carolina State University makes every effort to provide the student with surroundings which are pleasant and conducive to intellectual growth. Respecting the student as an individual, the University assures him or her the maximum of personal liberty within the limits necessary for orderly progression of class work. In return, the student is expected to pay serious attention to his or her purpose in attending this University and to observe rules of conduct consistent with maturity. Through the various services and activities identified with everyday life on campus, as well as through the several extracurricular organizations and functions, the student at North Carolina State has an excellent opportunity for acquiring experience in group leadership and community living which may serve one well in one's professional career.

As the student progresses in development, he or she will find many opportunities to increase growth in citizenship by participating in the activities of both one's academic class and of the student body in general. Following is a survey of the various activities at North Carolina State University.

## **STUDENT BODY GOVERNMENT AND STUDENT JUDICIAL SYSTEM**

When a student enters North Carolina State University, they become a member of a self-governing community. Legislative, executive and judicial authority, insofar as student affairs are concerned, rest with the Student Body Government which operates within the framework of over-all University administration. The Student Body Government members and judicial department members are elected in campus-wide elections. The student has a voice in campus government by participating in these elections. Often in general elections one is asked to vote on proposed changes in policies which affect the student body.

During each registration period, students are asked to sign either an honor code pledge or a recognition of academic integrity statement. These statements reflect the emphasis that North Carolina State University Student Government places upon academic integrity.

## **CLUBS AND SOCIETIES**

Through the various honorary, professional, technical and social organizations at North Carolina State University, the interested student finds opportunities to participate in activities that appeal to him, and to meet others who have similar interests.

## **HONORARY**

Honorary societies at North Carolina State University are Golden Chain, senior leadership; Blue Key, junior leadership; Thirty and Three, sophomore leadership; Phi Eta Sigma, men's freshman scholarship; Alpha Lambda Delta, women's freshman scholarship; and Phi Kappa Phi, junior, and senior and graduate students scholarship.

## **PROFESSIONAL AND TECHNICAL**

Each school at North Carolina State University sponsors or supervises a large number of professional and technical societies and clubs. Students in every area of instruction are encouraged to join with their fellow students in pursuing their common interests. Many of these organizations contribute greatly to the students's professional and social growth.

## **SOCIAL FRATERNITIES AND SORORITIES**

Eighteen national social fraternities have chapters at State. The University recognizes that the Interfraternity Council is the student organization responsible for fraternity matters and programs. The objectives of the Interfraternity Council are to promote the general interest and welfare of the associated fraternities and to insure cooperation among the fraternities, the faculty, the student body and the general public. A significant number of student leaders are members of the fraternity system. Fraternities have undergone great change during recent years. Present emphasis is directed toward developmental programming and meaningful small group relationships.

The social fraternities at North Carolina State are Alpha Gamma Rho, Alpha Phi Alpha, Delta Sigma Phi, FarmHouse, Kappa Alpha, Kappa Sigma, Lambda Chi Alpha, Phi Kappa Tau, Pi Kappa Alpha, Pi Kappa Phi, Sigma Alpha Epsilon, Sigma Alpha Mu, Sigma Chi, Sigma Nu, Sigma Phi Epsilon, Sigma Pi, Tau Kappa Epsilon and Theta Chi.

State also has two national social sororities, Sigma Kappa and Alpha Delta Pi.

## STUDENT PUBLICATIONS

A variety of publications, both general and school-sponsored, are edited and managed by student officers, with faculty members serving as advisers. A student may gain journalistic experience and training in writing, editing or management by working on these publications.

The three general publications, *The Agromeck*, the student broadcasting system, WPAK/WKNC-FM, and the *Technician*, are supported in large part by a publication fee included in each student's fees.

The *Agromeck* is the University yearbook, providing a record of the senior class and of the principal events of the school year. The yearbook recalls in pictures the varied activities of the student body throughout the year, and is published for the entire student body.

The *Technician* is the student newspaper issued three mornings a week and delivered to central locations on the campus, such as the coliseum, cafeterias, classroom buildings and the Student Supply Store. The *Technician* serves as a forum for student expression as well as a medium for campus news of particular interest to State students.

Although it is not a publication in the strictest sense of the word, WPAK/WKNC-FM (at 600 KC), serves the same function through a different medium. It offers many opportunities for extracurricula training in actual broadcasting techniques as well as training in administration and program planning. The station transmits on carrier current and educational FM.

Each student receives a copy of the current student handbook issue of the *North Carolina State Bulletin*, which contains detailed information about student organizations, activities and policies.

Several of the schools have their own publications issued under the general supervision of the particular school and dealing with material of special interest to students in that school. These publications include *Agri-Life* published by the School of Agriculture and Life Sciences; the *Pi-Ne-Tum*, published by the School of Forest Resources; *The Southern Engineer*, published by the School of Engineering; *The Textile Forum*, published by the School of Textiles; *The Publications of the School of Design*; and *The Scientist*, published by the School of Physical and Mathematical Sciences.

## ATHLETICS

North Carolina State University offers a variety of athletic activities. In addition to voluntary programs of intramural and intercollegiate sports, freshmen and sophomores are required to take two to four semesters of physical education. Juniors and seniors take physical education as an elective.

**Intramurals**—The University maintains an extensive program of intramural sports which is administered by the Department of Physical Education. Intramural activities are divided into three basic programs: the traditional sports program, the sports clubs program and the annual events program.

In the traditional sports program individual and team sports are offered to both men and women with participation being voluntary. Competition is divided into four divisions: (1) residence halls (2) fraternity (3) open and (4) women. Thirteen sports are offered in the residence hall and fraternity

divisions, while 11 sports are offered in the open division. In the women's division competition is offered in 13 different activities.

The sports clubs program is offered to individuals interested in opportunities to participate in certain activities usually at a higher skill level than the traditional sports program affords. At the present time, the active clubs on campus are: (1) weight training (2) badminton (3) women's basketball (4) women's tennis and (5) outing. Bowling, gymnastics and volleyball are expected to organize.

The North Carolina State University student also has the opportunity to participate in the annual events program. The men enjoy the competition of Big "4" Day with students from University of North Carolina - Chapel Hill, Wake Forest University and Duke University. During Co-Rec Day mixed teams, men and women, from North Carolina State compete against mixed teams from University of North Carolina - Chapel Hill, University of North Carolina - Charlotte and University of North Carolina - Greensboro.

Sports offered in the intramural program are correlated with those taught in the required physical education classes. Instruction in these sports is provided in the physical education classes and opportunity for increased competition is provided in the intramural program. An Intramural Advisory Board, composed of elected student representatives, recommends the policies to be administered by the intramural director.

**Intercollegiate**—The Department of Athletics conducts the University's intercollegiate athletics program involving 14 varsity sports. The Wolfpack schedules games and matches in football, soccer, and cross-country in the fall season; basketball, wrestling, swimming, fencing, rifle, and indoor track during the winter months; and baseball, track, tennis, golf, and lacrosse in the spring. The University is a member of the Atlantic Coast Conference and the National Collegiate Athletic Association (NCAA), and schedules conference and national rivals in the above sports. Wolfpack teams and individuals have an outstanding record for conference and regional athletic honors earned in past competition.

The athletics program is administered by the Athletics Director with the Athletics Council, made of five faculty, five alumni and five students, functioning to exercise institutional responsibility and control of the intercollegiate athletics program. The program is self-sufficient and is operated through gate receipts and student fees. Athletics grants-in-aid are provided by friends and alumni through the North Carolina State Student Aid Association (Wolfpack Club).

The University has excellent facilities, with double-decked Carter Stadium, featuring 41,000 sideline seats, Reynolds Coliseum holding 12,000 for basketball, and Doak Field having 3,800 seats for baseball. A nine-lane tartan track and a 2,200 seat swimming stadium, with a twenty-five yard by twenty-five meter pool, are other fine facilities available.

## MUSICAL ORGANIZATIONS

Since the early days of North Carolina State, musical organizations have played an important part in the life of the campus. These groups present concerts, furnish music for official university functions and perform at athletic events. The combined membership of these organizations constitutes the largest voluntary student organization on campus. Students may join the bands, choral organizations, orchestras, and pipes and drum by reporting for an audition at the time and location indicated in the orientation

schedule. Rehearsals are carefully arranged to avoid conflicts with study time or other classes.

The new music facilities are excellent. Being sound-proof, the building contains three large rehearsal halls, 14 individual practice rooms, plus ample storage and library space. This building is completely air conditioned and humidity controlled. The latest architectural and engineering techniques were employed to insure the best acoustical treatment possible.

**Bands**—The Symphonic Band, the Fanfare Band, the Brasschoir Band and the Marching Band make up the four divisions of the North Carolina State Bands. Each band serves a specific purpose in the musical life of the campus. Assignments to the various bands are made according to the interests and abilities of the individual students. The Symphonic, Fanfare and Brasschoir Bands are concert organizations, with the Symphonic Band having the most rigid requirements. The Marching Band, one of the best in the Atlantic Coast Conference, operates primarily during football season and is widely known for its spectacular half-time performances. The Clarinet Choir is an organization of Eb, Bb, Alto, Bass and Contrabass Clarinets. It is open to all regularly enrolled students.

**Choral Groups**—The two divisions of the North Carolina State Choral program are the Varsity Men's Glee Club and the University Choir. Placement in these organizations is made according to abilities and interests of the individual. The Varsity Men's Glee Club is by history and tradition the prime performing group on campus and maintains a high level of entrance requirements.

The University Choir also requires a high level of musical interests and abilities. The choir is so constituted that on occasion the male section performs as the Collegiate Men's Glee Club and the female section is utilized as the Women's Chorus. The Varsity and the Choir present several concerts each year, both on and off the campus. Radio and television appearances, recordings, tours and the providing of small ensembles for special occasions are additional activities. For those interested in additional study of singing techniques, a Voice Guild is offered.

**Orchestras**—Through a wide range of orchestral music, read and performed, suitable aesthetic needs of those actively involved in the orchestral offerings are met. Placement in the North Carolina State University Symphony Orchestra is according to the interest and ability of each individual. A position in the North Carolina State University Chamber Orchestra is dependent upon placement in the Symphony Orchestra. Both orchestras present several concerts each year on and off campus. An opportunity to coordinate musical efforts with professional musicians, recognized locally and nationally, is an integral part of these concerts. Provisions are made for those with an interest in string quartet and other small ensemble experience.

**NCS Pipes and Drums**—The newest musical organization on the North Carolina State campus is a highland bagpipe group. One purpose of this organization is to provide an opportunity for interested students to learn an instrument known to many of North Carolina's early settlers. Another purpose is for this group to represent the university through a unique and distinctive medium. Pipes and drums are provided. The organization performs at many university and community functions. No piping experience is necessary. Membership is open to all regularly enrolled students.

**The Guitar Guild**—This is an informal association of amateur guitarists formed to enliven interest in the guitar. Comprised of both students and faculty, the Guild sponsors group and private lessons, concerts, workshops,

and publishes guitar music. Weekly meetings afford members the chance to exchange ideas, improve technique, gain exposure to different styles of playing, and explore guitar literature.

**Musician-in-Residence**—North Carolina State University established this special chair in the Department of Music to help facilitate the cultural development of the entire University. Internationally known performers are appointed to the Musician-in-Residence position on a rotating basis. The person holding this appointment performs a wide range of functions including concerts and programs, both formal and informal, presented throughout the year for the benefit and enjoyment of all students, as well as providing his talents and imparting his knowledge to various schools and departments as requested. There is no charge to university organizations for this service. Information concerning this unique program may be had by contacting the Director of Music.

## UNIVERSITY STUDENT CENTER

The new University Student Center houses the major student organizations: Student Government, the *Technician*, WKNC-FM/WPAK, the *Agromeck*, the Inter-Residence Council, the Inter-Fraternity Council and the University Student Center Activity Board. It provides reading lounges, galleries, a newsstand and TV lounge, meeting rooms, a cafeteria on the top floor, a delicatessen and snack bar on the first floor, a coke lounge, ballroom, games room and 816-seat theater. In the Thompson Building the Center also operates one of the best equipped experimental theaters and craft shops in the Southeast. The University Student Center Annex in the Erdahl-Cloyd Wing of the D. H. Hill Library houses a snack bar, barbershop, billiards room and newsstand.

The University Student Center sponsors a wide variety of programs including amateur and professional theatrical productions, pop and classical concerts, lectures, films, art shows, dances, international fairs, volunteer services and instruction in a wide variety of crafts.

The Coordinator of Religious Affairs is also housed in the University Student Center. He sponsors, in cooperation with the YMCA and various chaplains assigned to the University, a wide range of activities from chapel services and seminars to multi-media productions.

# University Calendar \*

## SPRING SEMESTER 1973\*

January 8	Monday	Opening day (counseling, advising, new student orientation, etc.)
January 8	Monday	All students complete registration
January 9	Tuesday	Change day (late registration, drop/add)
January 10	Wednesday	First day of class
January 17	Wednesday	Lazy day to add a course
January 24	Wednesday	Last day to withdraw (or drop a course) with refund; last day to drop a course without a grade
March 2	Friday	Mid-term reports due; spring vacation begins at 10 p.m.
March 12	Monday	Classes resume at 8 a.m.
April 23	Monday	Holiday
April 27	Friday	Last day of classes
April 28-29	Saturday-Sunday	Reading days
April 30-May 9	Monday-Saturday	Final examinations
	Monday-Wednesday	
May 12	Saturday	
		Commencement

## SUMMER SESSIONS 1973\*

### *First Session*

May 28-29	Monday-Tuesday	Opening days (counseling, advising, etc.)
May 30	Wednesday	Registration day (orientation, new students)
May 31	Thursday	First day of classes
June 5	Tuesday	Last day to register; last day to withdraw (or drop a course) with refund; last day to drop a course without a grade
July 4	Wednesday	Holiday
July 5	Thursday	Last day of classes
July 6	Friday	Final examinations

### *Second Session*

July 10-11	Tuesday-Wednesday	Opening days (counseling, advising, etc.)
July 12	Thursday	Registration day (orientation, new students)
July 13	Friday	First day of classes

\*The calendar is tentative, subject to approval or change by the Board of Trustees.

July 18	Wednesday	Last day to register; last day to withdraw (or drop a course) with refund; last day to drop a course without a grade
August 16	Thursday	Last day of classes
August 17	Friday	Final examinations

### FALL SEMESTER 1973\*

August 20-24	Monday-Friday	Opening days (counseling, advising, late orientation, etc.)
August 27	Monday	General faculty meeting
August 27	Monday	All students complete registration
August 28	Tuesday	Change day (late registration, drop/add)
August 29	Wednesday	First day of classes
September 3	Monday	Holiday
September 5	Wednesday	Last day to add a course
September 12	Wednesday	Last day to withdraw (or drop a course) with refund; last day to drop a course without a grade
October 19	Friday	Mid-Term reports due
November 21	Wednesday	Thanksgiving vacation begins at 1 p.m.
November 26	Monday	Classes resume at 8 a.m.
December 7	Friday	Last day of classes
December 8-9	Saturday-Sunday	Reading Days
December 10-19	Monday-Saturday Monday-Wednesday	Final examinations

### SPRING SEMESTER 1974\*

January 7	Monday	Opening day (counseling, advising, new student orientation, etc.)
January 7	Monday	All students complete registration
January 8	Tuesday	Change day (late registration, drop/add)
January 9	Wednesday	First day of classes
January 16	Wednesday	Last day to add a course
January 23	Wednesday	Last day to withdraw (or drop a course) with refund; last day to drop a course without a grade
March 1	Friday	Mid-term reports due; spring vacation begins at 10 p.m.
March 11	Monday	Classes resume at 8 a.m.
April 15	Monday	Holiday
April 26	Friday	Last day of classes

\*The calendar is tentative, subject to approval or change by the Board of Trustees.

April 27-28	Saturday-Sunday	Reading days
April 29-May 8	Monday-Saturday	
	Monday-Wednesday	Final examinations
May 11	Saturday	Commencement

### **SUMMER SESSIONS 1974\***

#### *First Session*

May 27	Monday	Opening days (counseling, advising, etc.)
May 28	Tuesday	Registration day (orientation, new students)
May 29	Wednesday	First day of classes
June 3	Monday	Last day to register; last day to withdraw (or drop a course) with refund; last day to drop a course without a grade
July 2	Tuesday	Last day of classes
July 3	Wednesday	Final examinations

#### *Second Session*

July 9-10	Tuesday-Wednesday	Opening days (Counseling, advising, etc.)
July 11	Thursday	Registration day (orientation, new students)
July 12	Friday	First day of classes
July 17	Wednesday	Last day to register; last day to withdraw (or drop a course) with refund; last day to drop a course without a grade
August 15	Thursday	Last day of classes
August 16	Friday	Final examinations

### **FALL SEMESTER 1974\***

August 19-23	Monday-Friday	Opening days (counseling, advising, late orientation, etc.)
August 26	Monday	General faculty meeting
August 26	Monday	All students complete registration
August 27	Tuesday	Change day (late registration, drop/add)
August 28	Wednesday	First day of classes
September 2	Monday	Holiday
September 4	Wednesday	Last day to add a course
September 11	Wednesday	Last day to withdraw (or drop a course) with refund; last day to drop a course without a grade

\*The calendar is tentative, subject to approval or change by the Board of Trustees.

October 18	Friday	Mid-term reports due
November 27	Wednesday	Thanksgiving vacation beings at 1 p.m.
December 2	Monday	Classes resume at 8 a.m.
December 6	Friday	Last day of classes
December 7-8	Saturday-Sunday	Reading days
December 9-18	Monday-Saturday	
	Monday-Wednesday	Final examinations

\*The calendar is tentative, subject to approval or change by the Board of Trustees.

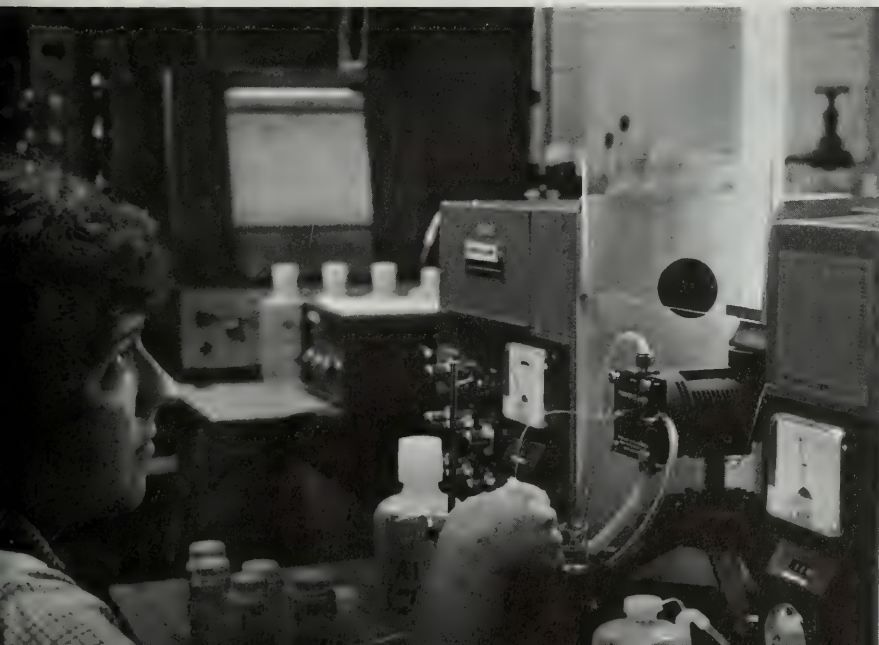


*Students in all programs find books and supplies in the Student Supply Store which operates a check cashing convenience, as does the campus student bank.*



*Musical groups make up the largest voluntary organization on campus.*

*This engineering student is involved in water pollution studies.*





*The D.H. Hill Library with its 11-story book tower houses a collection of 600,000 volumes, and will seat 2,200 persons. Photocopy service and equipment for reading microfilm and microcards serves students in all programs.*

## SCHOOLS AND PROGRAMS OF STUDY

There are eight major undergraduate academic divisions at North Carolina State University. These are the Schools of Agriculture and Life Sciences, Design, Education, Engineering, Forest Resources, Liberal Arts, Physical and Mathematical Sciences and Textiles. The programs of study are outlined by school. Information concerning specific courses is given in the section of the catalog on course descriptions.

In addition to information about the schools, this section contains descriptions of the military training program (ROTC), the Graduate School, Continuing Education and Summer Sessions.

Throughout the programs of study given in this section, departmental codes, course numbers and course titles are used. The key to the departmental code follows. This key will aid in locating individual courses in the course description section.

<b>CODE</b>	<b>NAME</b>	<b>MAS</b>	Marine Sciences
<b>AC &amp; ALS</b>	Agriculture and Life Sciences (General Courses)	<b>MAT</b>	Materials Engineering
<b>ANS</b>	Animal Science	<b>MB</b>	Microbiology
<b>ANT</b>	Anthropology	<b>MLE</b>	English (Foreign Students)
<b>ARC</b>	Architecture	<b>MLF</b>	French
<b>ART</b>	Art	<b>MLG</b>	German
<b>AS</b>	Aerospace Studies (ROTC)	<b>MLI</b>	Italian
<b>BAE</b>	Biological and Agricultural Engineering	<b>MLR</b>	Russian
<b>BCH</b>	Biochemistry	<b>MLS</b>	Spanish
<b>BMA</b>	Biomathematics	<b>MS</b>	Military Science (ROTC)
<b>BO</b>	Botany	<b>MUS</b>	Music
<b>BS</b>	Biological Sciences	<b>MY</b>	Meteorology
<b>CE</b>	Civil Engineering	<b>NE</b>	Nuclear Engineering
<b>CH</b>	Chemistry	<b>NTR</b>	Nutrition
<b>CHE</b>	Chemical Engineering	<b>OR</b>	Operations Research
<b>CS</b>	Crop Science	<b>OY</b>	Physical Oceanography
<b>CHE</b>	Chemical Engineering	<b>PD</b>	Product Design
<b>CSC</b>	Computer Science	<b>PE</b>	Physical Education
<b>DN</b>	Design	<b>PHI</b>	Philosophy
<b>E</b>	Engineering (General Courses)	<b>PHY</b>	Physiology
<b>EC</b>	Economics	<b>PMS</b>	Physical and Mathematical Sciences (General Course)
<b>ED</b>	Education (General Courses)*	<b>PO</b>	Poultry Science
<b>EE</b>	Electrical Engineering	<b>PP</b>	Plant Pathology
<b>EH</b>	Engineering Honors	<b>PS</b>	Politics
<b>EM</b>	Engineering Mechanics	<b>PSY</b>	Psychology
<b>ENG</b>	English	<b>PY</b>	Physics
<b>ENT</b>	Entomology	<b>REL</b>	Religion
<b>EO</b>	Engineering Operations	<b>RRA</b>	Recreation Resources Administration
<b>FOR</b>	Forest Resources**	<b>SOC</b>	Sociology
<b>FS</b>	Food Science	<b>SP</b>	Speech
<b>GN</b>	Genetics	<b>SSC</b>	Soil Science
<b>GY</b>	Geology	<b>ST</b>	Statistics
<b>HI</b>	History	<b>T</b>	Textiles (General Courses)
<b>HS</b>	Horticultural Science	<b>TC</b>	Textile Chemistry
<b>IA</b>	Industrial Arts	<b>TOX</b>	Toxicology
<b>IE</b>	Industrial Engineering	<b>TX</b>	Textile Technology
<b>ISO</b>	International Student Orientation	<b>UD</b>	Urban Design
<b>LAR</b>	Landscape Architecture	<b>UNI</b>	University Studies
<b>MA</b>	Mathematics	<b>WPS</b>	Wood and Paper Science and Technology
<b>MAE</b>	Mechanical and Aerospace Engineering	<b>ZO</b>	Zoology

\* This includes Adult and Community College Education, Agricultural Education, Guidance and Personnel Services, Industrial and Technical Education, and Mathematics and Science Education.

\*\* This includes Conservation and Forestry.



*Principles of science and business learned in the classroom and laboratory lead to hundreds of occupations in modern agriculture and life sciences.*

*A botany class participates in field identification techniques.*



# AGRICULTURE AND LIFE SCIENCES

Patterson Hall

J. E. LEGATES, *Dean*

E. W. GLAZENER, *Director of Academic Affairs*

Modern agriculture is a complex industry built on the principles of science and business. The basic sciences are the foundations for modern agricultural technology. These sciences applied to understanding the functions of living material offer a background as preparation for a professional agriculturist, environmentalist, or as a preparatory program for the medical and health related sciences. Likewise, the principles of economics and sociology provide background preparation for agricultural business management and public service aspects of society.

The objects of the academic program are as follows:

- (1) To provide an opportunity for a broad university education.
- (2) To provide a variety of learning experiences.
- (3) To offer a choice of specialization, sufficient for initial employment.
- (4) To provide background for graduate or professional programs.

A high percentage of all the gainfully employed persons in the United States are engaged in operations directly or indirectly related to food and fiber. For example, the food industry ranges from those who produce the food, supply material to the producer, and process the finished product to those who sell the products to the consumer. Hundreds of distinct occupations are represented in modern agriculture and biology. The demand for graduates is strong.

## FACILITIES

North Carolina State University is fortunate to have at its disposal the newest equipment and facilities in many fields. Laboratories are well equipped with modern equipment, such as an electron microscope, and with the necessary materials for learning and practicing the basic and applied sciences. Machinery and equipment, in some cases provided by private industry, keep students abreast of the latest technological advances. Extensive plant, animal and insect collections are available for teaching and research.

The D. H. Hill Library at North Carolina State University has a large collection of scientific books and periodicals which provide excellent source material for courses. In addition, students may draw from the specialized periodicals and textbooks in the departmental libraries.

Research stations of the University provide a practical classroom for many courses as well as a place where researchers can carry on basic and applied research.

## STUDENT ACTIVITIES

Students in the School of Agriculture and Life Sciences have ample opportunities to take part in broadening extracurricular activities. Most departments have student organizations which provide professional as well as social experience. Representatives of these clubs form the Agri-Life Council. This council is the student organization representing the school. Student tours provide an opportunity to see firsthand the application of classroom principles. In addition, students representing agronomy, animal science, horticultural science, food science, poultry science and soil science compete regionally and nationally in a number of activities providing student members a chance to learn by travel as well as by participation.

## CURRICULA OFFERINGS AND REQUIREMENTS

A freshman enrolling in agriculture and life sciences has a common core of courses the first year, courses that are appropriate in all curricula. This method allows the student time to study various programs before selecting a curricula in science (agricultural or biological), business or technology. In addition to the basic courses in English, biology, and physical and social sciences, the student selects a major in a department, an interdisciplinary program or an individualized course plan.

Departmental majors are offered in three general curricula as follows:

**Science**—agricultural economics, animal science, biological and agricultural engineering (joint program with the School of Engineering), botany, crop science, entomology, food science, horticultural science, medical technology, poultry science, rural sociology, soil science, wildlife biology and zoology. Premedical sciences are offered in this curriculum.

**Business**—emphasis on economics, combination programs in technology in animal science, crop science, horticultural science, poultry science and soil science.

**Technology**—biological and agricultural engineering, animal science, food science, horticultural science and poultry science.

**Interdepartmental and Interdisciplinary Programs**—These curricula offer the opportunity to select broad curriculum majors that involve two or more departments or schools:

**Biological Sciences**—A curriculum with emphasis on biological and physical sciences, especially designed for graduate or professional courses requiring a biology background.

**Conservation**—A curriculum concentrating on the use, preservation and improvement of natural resources. Administered jointly by the School of Agriculture and Life Sciences and the School of Forest Resources.

**Plant Protection**—A curriculum with emphasis on the application of chemical and biological principles in the control of plant diseases, insects and weeds. The curriculum is administered by the Departments of Entomology, Crop Science and Plant Pathology.

**Agronomy**—A technical curriculum dealing with the fundamentals of crop production and soil management. The curriculum is administered by the Departments of Crop Science and Soil Science.

**Individualized Study Program**—an experimental program with the student planning his curriculum assisted by a faculty advisory committee.

In addition to these formal programs, a number of arrangements that offer two areas of concentration are available according to the interest of the student.

## HONORS PROGRAMS

The School of Agriculture and Life Sciences has a comprehensive Honors Program for qualified freshmen and sophomores interested in participating in seminar discussion programs on broad topics. These sessions are led by outstanding professors.

Qualified juniors and seniors have an opportunity to participate in an independent research program. Faculty direction is provided on an individual basis to each student. The student has the opportunity to select his project.

## DEGREES

The Bachelor of Science degree is conferred upon the satisfactory completion of one of the curricula in this school.

The degrees of Master of Science, Master of Agriculture and Master of Life

Sciences are offered in the various departments of agriculture and life sciences after satisfactory completion of at least one year of graduate study in residence. The latter two are referred to as "professional degree programs" in the sections on graduate study.

The Doctor of Philosophy degree is offered by the following departments: economics, biological and agricultural engineering, animal science, biochemistry, crop science, botany, microbiology, entomology, food science, genetics, horticulture, nutrition, plant pathology, sociology and anthropology, soil science and zoology.

Further information on graduate offerings may be found in the Graduate School Catalog.

## OPPORTUNITIES

Broad and fascinating opportunities in business, industry, education and government are open to graduates of agriculture and life sciences. Some of the areas in which graduates are employed are:

*Business and Industry*—banking and credit, insurance, farm management, cooperatives, land appraisal, marketing, transportation, food chains, food packing, machinery and equipment, chemicals, fertilizer, feed manufacturing, seed processing.

*Communications*—writing, reporting, radio, television, newspapers, magazines, advertising, publications.

*Conservation*—soil, water, range, forest, fish, wildlife parks, recreation.

*Education*—high school and college instruction in agriculture or biology, agricultural extension, governmental, and industrial agencies.

*Farming and Ranching*—general livestock, field crops, fruits, vegetables, poultry, ornamentals.

*Preprofessional and Graduate Preparation*—premedical programs for training for medical, dental and veterinary colleges, graduate programs.

*Research*—production, marketing, engineering, processing, conservation, organizational structure, group behavior.

*Services*—inspection and regulation, production field service, health services, quality control and grading, agricultural technology and consulting.

A placement office as a part of the University Career Planning and Placement Center is maintained to assist graduates in career development and placement.

## INTERNATIONAL ASPECTS

An International Seminar is offered to those students who are interested. In addition, an International Option, requiring modern language and 12 semester hours of appropriate courses in the social sciences, is available for interested students enrolled in any curricula.

## FRESHMAN YEAR

The curricula in the School of Agriculture and Life Sciences have a common freshman year with the exception of the science program in biological and agricultural engineering. For the agricultural science, biological and agricultural engineering freshman year, see freshman year in the School of Engineering.

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ALS 103 Orientation .....	1	ENG 112 Composition and Reading .....	3
BS 100 General Biology .....	4	MA 112 Analytic Geometry and Calculus A . . .	4
ENG 111 Composition and Rhetoric .....	3	or	
Social Science and Humanities Elective ....	3	MA 114 Topics in Modern Mathematics ....	3
MA 111 Algebra and Trigonometry* .....	4	Social Science and Humanities Elective ....	3
Physical Education .....	1	CH 101 General Chemistry I .....	4
(Military Science or Air Science may be elected)		Physical Education .....	1
	—	(Military Science or Air Science may be elected)	—
	16		14-15

\* Does not contribute to the 130 semester hours required in the biological sciences curriculum.

## CURRICULA IN AGRICULTURE AND LIFE SCIENCES\*

Science, business and technology are three curricula offered in this school. All departments offer the science curriculum. Several departments offer the choice of either science or technology. In addition, several departments are participating in interdisciplinary programs.

A business curriculum is offered in agricultural economics or in combination with the technology curriculum in animal science, crop science, horticultural science, poultry science and soil science.

All the curricula have a core of required courses on a school basis. Courses peculiar to a specific department are listed under the departmental requirements. Listed below are the required courses by curriculum on a school basis.

## SCIENCE

	<i>Credits</i>		
ALS 103 Orientation .....	1	MA 111 Algebra and Trigonometry .....	4
<i>Languages</i> (12 Credits)		MA 112 Analytic Geometry and Calculus A . . .	4
ENG 111 Composition and Rhetoric .....	3	or	
ENG 112 Composition and Reading .....	3	MA 114 Topics in Modern Mathematics ....	3
Electives (English or Modern Language) ....	6	PY 221 College Physics .....	5
<i>Social Sciences and Humanities</i> (21 Credits)		or	
Electives from Group D .....	21	PY 211, PY 212 General Physics .....	8
<i>Physical and Biological Sciences</i> (28-32 Credits)		<i>Electives</i> (60-64 Credits)	
BS 100 General Biology .....	4	Restricted Electives from Group A .....	22-26
Biological Sciences Elective .....	4	Departmental Requirements and Electives ..	26
CH 101 General Chemistry I .....	4	Free Electives .....	12
CH 103 General Chemistry II .....	4	Subtotal .....	126
or		Physical Education .....	4
CH 107 Principles of Chemistry .....	4	Total Hours for Graduation .....	130**

## BUSINESS

<i>Accounting:</i>	<i>Credits</i>		
EC 260 Accounting I—Concepts of Financial Reporting .....	3	EC 362 Production Cost Analysis & Control .....	3
EC 261 Accounting II—Financial Information Systems .....	3	EC 460 Specialized Financial Reporting Theory and Practice .....	3
EC 262 Managerial Uses of Cost Data ....	3	EC 464 Income Taxation .....	3
EC 360 Financial Reporting Theory & Practice I .....	3	EC 466 Examination of Financial Statements .....	3
EC 361 Financial Reporting Theory & Practice II .....	3	EC 468 Professional Accountancy Resumé .....	3

#### *Production:*

EC 303	Farm Management .....	3
EC 425	Industrial Management .....	3
EC 551	Agricultural Production Economics .....	3

#### *Marketing:*

EC 311	Agricultural Markets .....	3
EC 411	Marketing Methods .....	3
EC 521	Markets and Trade .....	3

#### *Finance:*

EC 402	Financial Institutions .....	3
EC 415	Farm Appraisal and Finance .....	3
EC 420	Corporation Finance .....	3

#### *Personnel:*

EC 426	Personnel Management .....	3
EC 431	Labor Economics .....	3
EC 432	Industrial Relations .....	3

#### *Business Management:*

EC 310	Economics of the Firm .....	3
EC 525	Management Policy and Decision Making .....	3

#### *Electives:*

EC 301	Production and Prices .....	3
EC 302	National Income and Economic Welfare .....	3
Group B Courses		

Students in the business curriculum complete a minimum of 24 semester hours in Group B courses. One course is required in the areas of accounting, production, marketing, finance, personnel and management. In addition, two courses are elected from Group B course offerings.

## TECHNOLOGY

#### *Credits*

ALS 103	Orientation .....	1
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#### *Languages (12 Credits)*

ENG 111	Composition and Rhetoric .....	3
ENG 112	Composition and Reading .....	3
SP 231	Expository Speaking .....	3
Electives	(English or Modern Language) .....	3

#### *Social Sciences and Humanities (21 Credits)*

Electives from Group D .....	21
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#### *Physical and Biological Sciences (32-33 Credits)*

BS 100	General Biology .....	4
	Biological Sciences Elective .....	4
CH 101	General Chemistry I .....	4

\* Group A includes the physical and biological sciences; Group B, economics and business management; Group C, applied science and technology; Group D, social sciences and humanities.

\*\* All curricula require the completion of one course in literature.

## ELECTIVES

The following lists provide typical courses that are elected from the four block groupings—A, B, C and D. Additional courses may be selected by checking with the office of the Director of Academic Affairs.

### GROUP A

#### *PHYSICAL SCIENCES:*

##### *Biochemistry:*

BCH 351	Elementary Biochemistry
BCH 452	Experimental Biochemistry

##### *Chemistry:*

CH 107	Principles of Chemistry
CH 220	Introductory Organic Chemistry

CH 221	Organic Chemistry I
CH 223	Organic Chemistry II
CH 315	Quantitative Analysis
CH 331	Introductory Physical Chemistry

##### *Computer Science:*

CSC 111	Algorithmic Languages I
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- CSC 112 Basic Computer Organization  
and Assembly Language  
CSC 211 Programming Languages

*Geosciences:*

- GY 120 Physical Geology  
GY 208 Environmental Physical Geology  
MY 486 Weather and Climate

*Mathematics:*

Must use one or the other of the following  
two sequences: MA 111, 112, 212 or MA 102,  
201, 202

- MA 102 Analytic Geometry and Calculus I  
MA 111 Algebra and Trigonometry  
MA 112 Analytic Geometry and  
Calculus A  
MA 114 Topics in Modern Mathematics  
MA 201 Analytic Geometry and  
Calculus II  
MA 202 Analytic Geometry and  
Calculus III

- MA 212 Analytic Geometry and  
Calculus B  
MA 301 Applied Differential Equations I

*Meteorology:*

- MY 411 Introductory Meteorology

*Physics:*

- PY 223 Astronomy and Astrophysics  
PY 407 Introduction to Modern Physics

*Soil Science:*

- SSC 200 Soils  
SSC 511 Soil Physics  
SSC 520 Soil and Plant Analysis  
SSC 522 Soil Chemistry

*Statistics:*

- ST 311 Introduction to Statistics  
ST 361 Introduction to Statistics  
for Engineers

## BIOLOGICAL SCIENCES:

*Animal Science:*

- ANS 301 (FS 301, NTR 301) Nutrition  
and Man  
ANS 401 Reproductive Physiology  
ANS 405 Lactation  
ANS 415 (NTR 415, PO 415) Comparative  
Nutrition  
ANS 502 (PHY 502) Reproductive  
Physiology of Vertebrates

*Biological and Agricultural Engineering:*

- BAE 303 Energy Conversion for  
Agricultural Production

*Biological Sciences:*

- BS 480 Air Pollution Biology

*Botany:*

- BO 200 Plant Life  
BO 360 (ZO 360) Introduction to Ecology  
BO 400 Plant Diversity  
BO 402 (CS 402) Economic Botany  
BO 403 Systematic Botany  
BO 414 (ZO 414) Cell Biology  
BO 421 Plant Physiology

*Entomology:*

- ENT 301 Introduction to Forest Insects  
ENT 312 Introduction to Economic  
Insects  
ENT 502 Insect Diversity  
ENT 503 Functional Systems of Insects  
ENT 550 Fundamentals of Insect  
Control  
ENT 562 Agricultural Entomology  
ENT 582 (ZO 582) Medical and  
Veterinary Entomology

*Food Science:*

- FS 402 Food Chemistry  
FS 405 (MB 405) Food Microbiology  
FS 506 (MB 506) Advanced Food  
Microbiology

*Genetics:*

- GN 504 Human Genetics  
GN 532 (ZO 532) Biological Effects of  
Radiations  
GN 540 (ZO 540) Evolution

*Microbiology:*

- MB 401 General Microbiology  
MB 405 (FS 405) Food Microbiology  
MB 506 (FS 506) Advanced Food  
Microbiology  
MB 514 Microbial Metabolism  
MB 571 Virology

*Plant Pathology:*

- PP 315 Plant Diseases  
PP 318 (FOR 318) Forest Pathology  
PP 500 Plant Disease Control

*Poultry Science:*

- PO 401 Poultry Diseases  
PO 415 (ANS 415, NTR 415) Comparative  
Nutrition  
PO 524 (ZO 524) Comparative  
Endocrinology

*Zoology:*

- ZO 201 Animal Life  
ZO 223 Comparative Anatomy  
ZO 315 General Parasitology  
ZO 345 Histology  
ZO 350 Invertebrate Zoology  
ZO 351 Vertebrate Zoology  
ZO 360 (BO 360) Introduction to Ecology  
ZO 361 Vertebrate Embryology  
ZO 414 (BO 414) Cell Biology  
ZO 420 Fishery Science  
ZO 421 Vertebrate Physiology  
ZO 441 Ichthyology  
ZO 524 (PO 524) Comparative  
Endocrinology  
ZO 540 (GN 540) Evolution

## GROUP B

### ECONOMICS AND BUSINESS MANAGEMENT:

#### Economics:

EC 260	Accounting I—Concepts of Financial Reporting
EC 261	Accounting II—Financial Information Systems
EC 262	Managerial Uses of Cost Data
EC 301	Production and Prices
EC 302	National Income and Economic Welfare
EC 303	Farm Management
EC 310	Economics of the Firm
EC 311	Agricultural Markets
EC 317	Introduction to Methods of Economic Analysis
EC 360	Financial Reporting Theory & Practice I
EC 361	Financial Reporting Theory & Practice II
EC 362	Production Cost Analysis & Control
EC 402	Financial Institutions
EC 407	Business Law I

EC 408	Business Law II
EC 411	Marketing Methods
EC 415	Farm Appraisal and Finance
EC 420	Corporation Finance
EC 425	Industrial Management
EC 426	Personnel Management
EC 430	Agricultural Price Analysis
EC 431	Labor Economics
EC 432	Industrial Relations
EC 440	Economic Development
EC 460	Specialized Financial Reporting Theory and Practice
EC 464	Income Taxation
EC 466	Examination of Financial Statements
EC 468	Professional Accountancy Résumé

#### Mathematics:

MA 122	Mathematics of Finance and Elementary Statistics
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## GROUP C

### APPLIED SCIENCE AND TECHNOLOGY:

#### Agricultural Communications:

AC 311	Communications Methods and Media
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#### Animal Science:

ANS 200	Introduction to Animal Science
ANS 204	Livestock Feeds and Feeding
ANS 302	Selecting Dairy and Meat Animals
ANS 308	Advanced Selecting Dairy and Meat Animals
ANS 402	Beef Cattle Management
ANS 403	Swine Management
ANS 404	Dairy Cattle Management
ANS 406	Sheep Management
ANS 409 (FS 409)	Meat and Meat Products
ANS 410	Horse Management
ANS 411	Breeding and Improvement of Domestic Animals
ANS 505	Diseases of Farm Animals
ANS 508 (GN 508)	Genetics of Animal Improvement

#### Biological and Agricultural Engineering:

BAE 211	Farm Machinery
BAE 321	Irrigation Terracing and Erosion Control
BAE 331 (FS 331)	Food Engineering
BAE 332	Farm Structures
BAE 341	Farm Electrification and Utilities
BAE 411	Farm Power and Machinery
BAE 433	Crop Preservation and Processing

#### Crop Science:

CS 211	Crop Science
CS 311	Field Crop Production
CS 312	Pastures and Forage Crops
CS 315	Turf Management
CS 413	Plant Breeding

CS 414	Weed Science
CS 511	Tobacco Technology
CS 513	Physiological Aspects of Crop Production
CS 514 (HS 514)	Principles and Methods in Weed Science

#### Food Science:

FS 331 (BAE 331)	Food Engineering
FS 404 (PO 404)	Poultry Products
FS 409 (ANS 409)	Meat and Meat Products

#### Horticultural Science:

HS 201	Principles of Horticulture
HS 301	Plant Propagation
HS 342	Landscape Horticulture
HS 421	Fruit Production
HS 432	Vegetable Production
HS 441, HS 442	Floriculture I and II

#### Poultry Science:

PO 201	Poultry Science and Production
PO 301	Evaluation of Live Poultry
PO 351	Grading and Evaluation of Poultry Products
PO 402	Commercial Poultry Enterprises
PO 404 (FS 404)	Poultry Products
PO 520 (GN 520)	Poultry Breeding

#### Soil Science:

SSC 341	Soil Fertility and Fertilizers
SSC 452	Soil Classification
SSC 461	Soil and Water Conservation
SSC 462	Soil Management Systems
SSC 472	Forest Soils

#### Zoology:

ZO 212	Basic Anatomy and Physiology
ZO 221	Conservation of Natural Resources

## GROUP D

### SOCIAL SCIENCES AND HUMANITIES:

The student is required to complete 21 semester hours of Group D courses in all degree programs. Not more than six semester hours are to come from one departmental area. It is strongly recommended that the student be exposed to courses in each of the major course areas outlined below, although the final selection is with the student and his adviser.

#### AREA I

##### *Anthropology:*

All courses

##### *Economics:*

- |                 |   |
|-----------------|---|
| EC 205          | Economic Activity                             |
| EC 206          | Price System                                  |
| EC 212          | Economics of Agriculture                      |
| EC 370 (HI 370) | The Rise of Industrialism                     |
| EC 410          | Public Finance and Fiscal Policy              |
| EC 413          | Competition, Monopoly and Public Policy       |
| EC 441          | Agricultural Development in Foreign Countries |
| EC 442          | Evolution of Economic Ideas                   |
| EC 448          | International Economics                       |
| EC 470 (HI 470) | Evolution of the American Economy             |
| EC 475          | Comparative Economic Systems                  |

##### *Psychology:*

All courses

##### *Sociology:*

All courses

#### AREA II

##### *History:*

All courses

##### *Politics:*

All courses

##### *Social Studies:*

All courses

##### *University Studies:*

All courses

#### AREA III

##### *Art:*

All courses

##### *English:*

Literature courses only

##### *Modern Language:*

Courses numbered 200 and above

##### *Music:*

Courses number 200 and above

##### *Philosophy:*

All courses

##### *Religion:*

All courses

## ADULT AND COMMUNITY COLLEGE EDUCATION

(Also see education.)

The adult and community college education faculty offers instruction primarily at the graduate level. The department is jointly administered by the School of Agriculture and Life Sciences and the School of Education. For details, see the School of Education, pages 129-130.

## AGRONOMY

(See crop science and soil science, pages 85 or 107.)

## ANIMAL SCIENCE

Polk Hall

*Professor I. D. PORTERFIELD, Head of the Department*

## TEACHING AND RESEARCH

*Professors:* E. R. BARRICK, E. G. BATTE, A. J. CLAWSON, L. GOODE, J. M. LEATHERWOOD, J. G. LECCE, J. E. LEGATES, B. T. MCDANIEL, R. D. MOCHRIE, H. A. RAMSEY, H. A. SCHNEIDER, F. H. SMITH, L. C. ULBERG, G. H. WISE; *Adjunct Professor:* J. H. GAINER; *Professors Emeriti:* C. D. GRINNELLS, H. A. STEWART; *Associate Professors:* E. V. CARUOLO, D. G. DAVENPORT, E. U. DILLARD, E. J. EISEN, R. W. HARVEY, E. E. JONES, J. J. MCNEILL, D. J. MONCOL, R. M. MYERS, A. H. RAKES, O. W. ROBISON, J. C. WILK; *Assistant Professors:* J. A. COALSON, B. H. JOHNSON, W. L. JOHNSON (Peru); *Adjunct Assistant Professor:* B. D. HARRINGTON; *Assistant Professor Emeritus:* J. L. MOORE; *Associate Members of the Faculty:* G. MATRONE, S. B. TOVE (Biochemistry); C. H. HILL (Poultry Science); H. J. GOLD (Statistics)

## EXTENSION

*Professor A. V. ALLEN, In Charge, Animal Husbandry Extension*

*Professor M. E. SENDER, In Charge, Dairy Husbandry Extension*

*Associate Professor D. G. SPRUILL, In Charge, Swine Husbandry Extension*

*Professors:* R. F. BEHLOW, T. C. BLALOCK, J. S. BUCHANAN, G. HYATT JR., G. S. PARSONS, J. W. PATTERSON, J. R. WOODARD; *Associate Professors:* J. R. JONES, F. N. KNOTT, F. D. SARGENT, C. M. STANISLAW; *Assistant Professors:* G. B. CREED, D. P. WESEN; *Assistant Professor Emeritus:* R. R. RICH; *Extension Dairy Husbandry Specialist Emeritus:* J. A. AREY; *Instructors:* K. R. BUTCHER, C. M. REESE

Undergraduate students in animal science study subjects related to various phases of animal industry. Training is provided in nutrition, physiology, breeding and disease and there are opportunities for the application of basic scientific training in the husbandry areas. Options for course selection by each student make it possible for those with varying backgrounds and wide-ranging interests to become involved in training that will be stimulating and rewarding.

## OPPORTUNITIES

There are many opportunities for students majoring in animal science. These include farm, dairy and livestock management careers, jobs as fieldmen for breed association and livestock organizations, agricultural extension, educational work in business and industries serving agriculture, meat grading, agricultural communications in animal science, feed manufacturing, sales work in feeds and equipment, marketing dairy cattle and dairy products, and supervising livestock and farm loans with banks and lending agencies. Many students in veterinary science obtain degrees in animal science as well. In addition, students may elect further study at the graduate level, after which they will find opportunities in teaching, research and development.

## UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in animal science may be obtained under any of the three curricula offered by the School of Agriculture and Life Sciences. For the basic requirements and freshman year see pages 65-70.

## CURRICULA IN ANIMAL SCIENCE

### BUSINESS PROGRAM

This curriculum is selected by students desiring a background in business with a technical knowledge of animal science. The program requires the completion of courses in the technology curriculum, page 67, and the economic and business courses as outlined on page 69.

## SCIENCE PROGRAM

See the typical curriculum, beginning on page 72, below.

### *Departmental Requirements*

ANS 200	Introduction to Animal Science ..	4
ANS 490	Animal Science Seminar .....	1
GN 411	The Principles of Genetics .....	3
MB 401	General Microbiology .....	4
ZO 421	Vertebrate Physiology .....	3
Departmental Electives .....		6

### *Minimum of nine credits from the following courses:*

ANS 401	Reproductive Physiology .....	3
ANS 405	Lactation .....	3
ANS 411	Breeding and Improvement of Domestic Animals .....	3
ANS 415 (NTR 415, PO 415)	Comparative Nutrition .....	3
ANS 505	Diseases of Farm Animals .....	3
Total Hours for Graduation .....		130

## TECHNOLOGY PROGRAM

See typical curriculum on page 73.

### *Departmental Requirements*

ANS 200	Introduction to Animal Science ..	4
ANS 204	Livestock Feeds and Feeding ....	3
ANS 490	Animal Science Seminar .....	1
GN 411	The Principles of Genetics .....	3
ZO 421	Vertebrate Physiology .....	3
Departmental Elective .....		3

### *Minimum of nine credits from the following courses:*

ANS 401	Reproductive Physiology .....	3
ANS 405	Lactation .....	3
ANS 411	Breeding and Improvement of Domestic Animals .....	3

### *Minimum of five credits from the following courses:*

ANS 415 (NTR 415, PO 415)	Comparative Nutrition .....	3
ANS 505	Diseases of Farm Animals .....	3
ANS 302	Selecting Dairy and Meat Animals .....	2
ANS 402	Beef Cattle Management .....	3
ANS 403	Swine Management .....	3
ANS 404	Dairy Cattle Management .....	3
ANS 406	Sheep Management .....	3
ANS 410	Horse Management .....	3
Total Hours for Graduation .....		130

## TYPICAL CURRICULUM IN ANIMAL SCIENCE

### SCIENCE PROGRAM

For the freshman year see pages 65-66.

#### SOPHOMORE YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
ANS 200	Introduction to Animal Science ..	ANS 204	Livestock Feeds & Feeding .....
CH 220	Introductory Organic Chemistry*	CH 223	Organic Chemistry II
or		or	
CH 221	Organic Chemistry I .....	Group A	Elective .....
MA 212	Analytic Geometry and Calculus B	Social Science & Humanities	Elective .....
or		PY 221	College Physics .....
Group A	Elective .....	Physical Education .....	
SP 231	Expository Speaking .....		
Free Elective .....			
Physical Education .....			
	18		16

\* The student's choice of CH 220 or CH 221 is dependent upon his previous completion of either CH 103, General Chemistry II, or CH 107, Principles of Chemistry.

#### JUNIOR YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
BCH 351	Elementary Biochemistry .....	ANS 409 (FS 409)	Meat & Meat Products ..
Social Science & Humanities	Electives .....	ANS 415 (NTR 415, PO 415)	Comparative Nutrition .....
ZO 421	Vertebrate Physiology .....	ENG 205	Reading for Discovery .....
Free Elective .....		GN 411	The Principles of Genetics .....
	16	MB 401	General Microbiology .....
			16

## SENIOR YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
ANS 411 Breeding & Improvement of Domestic Animals .....	3	ANS 401 Reproductive Physiology .....	3
ANS 505 Diseases of Farm Animals .....	3	ANS 402 Beef Cattle Management .....	3
Animal Science Elective .....	3	ANS 403 Swine Management .....	3
Social Science & Humanities Elective .....	3	ANS 490 Animal Science Seminar .....	1
Free Electives .....	5-6	Social Science & Humanities Elective .....	3
		Free Elective .....	3
	17-18		16
		Total Hours for Graduation .....	130

## TYPICAL CURRICULUM IN ANIMAL SCIENCE

### TECHNOLOGY PROGRAM

For the freshman year see pages 65-66.

## SOPHOMORE YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
ANS 200 Introduction to Animal Science ..	4	ANS 204 Livestock Feeds & Feeding .....	3
CH 103 General Chemistry II .....	4	Social Science & Humanities Elective .....	3
Social Science & Humanities Elective .....	3	PY 221 College Physics .....	5
SP 231 Expository Speaking .....	3	CH 220 Introductory Organic Chemistry ..	4
Physical Education .....	1	Physical Education .....	1
	15		16

## JUNIOR YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
ANS 505 Diseases of Farm Animals .....	3	ANS 302 Selecting Dairy and Meat Animals .....	2
ENG 205 Reading for Discovery .....	3	ANS 402 Beef Cattle Management .....	3
ZO 421 Vertebrate Physiology .....	3	CS 312 Pastures & Forage Crops .....	3
SSC 200 Soils .....	4	GN 411 The Principles of Genetics .....	3
Free Elective .....	4	Social Science & Humanities Elective .....	3
	17	Free Elective .....	3
			17

## SENIOR YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
ANS 308 Advanced Selecting Dairy & Meat Animals .....	1	ANS 401 Reproductive Physiology .....	3
ANS 410 Horse Management .....	3	ANS 403 Swine Management .....	3
ANS 411 Breeding & Improvement of Domestic Animals .....	3	ANS 409 (FS 409) Meat & Meat Products ..	3
Social Science & Humanities Electives .....	6	ANS 490 Animal Science Seminar .....	1
Free Electives .....	5-6	EC 260 Accounting I—Concepts of Financial Reporting .....	
	18-19	or	
		Group A, B or C Elective .....	3
		Free Elective .....	3
			16
		Total Hours for Graduation .....	130

## GRADUATE STUDY

The department offers the Master of Science, a professional master's program and the Doctor of Philosophy degrees in animal husbandry, dairy husbandry, animal biochemistry and nutrition, animal diseases, animal physiology and animal breeding. Prospective applicants should consult the Graduate School Catalog.

# BIOCHEMISTRY

Polk Hall

*Professor* GENNARD MATRONE, *Head of the Department*

*Professors:* F. B. ARMSTRONG, H. R. HORTON, J. S. KAHN, I. S. LONGMUIR, A. R. MAIN, S. B. TOVE; *Associate Professor:* E. C. SISLER; *Assistant Professors:* J. A. KNOPP, ELIZABETH C. THEIL, *Associate Members of the Faculty:* L. W. AURAND (Food Science), J. BORDNER, S. G. LEVINE, W. P. TUCKER (Chemistry), E. G. JONES (Animal Science)

The Department of Biochemistry offers instruction at the undergraduate and graduate levels. Undergraduate courses are designed to provide students from a number of curricula with a fundamental background in the science of biochemistry. The graduate program is designed to train scientists for research and teaching careers in biochemistry and related fields.

The Department of Biochemistry is jointly administered by the School of Agriculture and Life Sciences and the School of Physical and Mathematical Sciences.

## UNDERGRADUATE CURRICULUM

The Department offers an undergraduate curriculum leading to the B.S. degree in the biological sciences with an emphasis in biochemistry. See below and page 68.

## BIOLOGICAL SCIENCES CURRICULUM

### BIOCHEMISTRY EMPHASIS

#### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I .....	4	CH 107 Principles of Chemistry .....	4
MA 102 Analytic Geometry & Calculus I		MA 201 Analytic Geometry & Calculus II	
or		or	
MA 112 Analytic Geometry & Calculus A ..	4	MA 212 Analytic Geometry & Calculus B ..	3-4
ENG 111 Composition & Rhetoric .....	3	ENG 112 Composition & Reading .....	3
ALS 103 Orientation .....	1	BS 100 General Biology .....	4
Social Science and Humanities Elective .....	3	Physical Education .....	1
Physical Education .....	1		
	16		15-16

#### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I .....	4	CH 223 Organic Chemistry II .....	4
MA 202 Analytic Geometry & Calculus III		BO 200 Plant Life .....	4
or		Modern Foreign Language .....	3
MA 114 Topics in Modern Mathematics ...	3-4	Social Science and Humanities Elective .....	3
Modern Foreign Language .....	3	Physical Education .....	1
ZO 201 Animal Life .....	4		
Physical Education .....	1		15
	15-16		

#### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 301 Applied Differential Equations I ..	3	BCH 351 Elementary Biochemistry .....	3
CH 428 Qualitative Organic Analysis		CH 431 Physical Chemistry I .....	3-4
or		or	
CH 315 Quantitative Analysis .....	3-4	CH 331 Introductory Physical Chemistry	
PY 211 General Physics .....	4	PY 212 General Physics .....	4
or		or	
PY 205 General Physics		PY 208 General Physics	
BO 360 (ZO 360) Introduction to Ecology .	4	GN 411 The Principles of Genetics .....	3
Social Science and Humanities Elective .....	3	GN 412 Elementary Genetics Laboratory ..	1
		Social Science and Humanities Elective .....	3
	17-18		17-18

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BCH 452 Experimental Biochemistry .....	3	MB 401 General Microbiology .....	4
CH 433 Physical Chemistry II		ST 311 Introduction to Statistics	
or		or	
Free Elective .....	3	CSC 111 Algorithmic Languages I	
BO 421 Plant Physiology		or	
or		Mathematics Elective .....	2-3
ZO 421 Vertebrate Physiology		Social Science and Humanities Electives ....	6
or		Free Electives .....	3-4
ZO 414 (BO 414) Cell Biology .....	3-4		18-19
Social Science and Humanities Elective ....	3		
Free Elective .....	3-4	Total Hours for Graduation .....	130
	15-17		

## GRADUATE STUDY

The Department of Biochemistry offers programs of study leading to the Master of Science and Doctor of Philosophy degrees. Prospective students should consult the Graduate School Catalog for additional information.

## BIOLOGICAL AND AGRICULTURAL ENGINEERING

(Also see engineering.)

David S. Weaver Laboratories

*Professor F. J. HASSLER, Head of the Department*

## TEACHING AND RESEARCH

*Professors:* H. D. BOWEN, J. W. DICKENS (USDA), J. M. FORE, D. H. HOWELLS, W. H. JOHNSON, C. W. SUGGS; *Professor Emeriti:* G. W. GILES, J. W. WEAVER, JR.; *Associate Professors:* G. B. BLUM, JR., J. D. HESKETH (USDA), R. G. HOLMES, E. L. HOWELL, B. K. HUANG, E. G. HUMPHRIES, W. F. MCCLURE, R. P. ROHRBACK, T. B. WHITAKER (USDA), C. R. WILLEY (USDA), R. E. WILLIAMSON (USDA), E. H. WISER, J. H. YOUNG; *Assistant Professors:* C. F. ABRAMS, JR., G. R. BAUGHMAN, F. J. HUMENIK, M. R. OVERCASH, R. W. SKAGGS, R. S. SOWELL; *Associate Members of the Faculty:* D. D. HAMANN, V. A. JONES (Food Science)

## EXTENSION

*Associate Professor G. J. KRIZ, Associate Head in Charge of Extension*

*Professor Emeritus:* H. M. ELLIS; *Associate Professors:* L. B. DRIGGERS, J. W. GLOVER, W. C. WARRICK, R. W. WATKINS; *Associate Professor Emeritus:* J. C. FERGUSON; *Assistant Professors:* E. O. BEASLEY, R. E. SNEED

Students in biological and agricultural engineering are educated and trained to deal with problems of agriculture that are engineering in nature. Involved are the application of scientific and engineering principles to the conservation and utilization of water and soil, the development of power and labor-saving devices for all phases of agricultural production, the design of structures and equipment for housing and handling livestock and field products, and the processing and marketing of farm products.

The need for men to carry out the technical aspects such as development and research as well as less technical work, such as sales and service of farm equipment, requires the offering of two distinct curricula as described below.

The curricula lead to the Bachelor of Science degree.

## OPPORTUNITIES

Persons trained in biological and agricultural engineering under the science curriculum are qualified for positions in design development and research in public institutions and in industry and for teaching and extension work in institutions of higher education. The curriculum also provides adequate training for post-graduate work leading to advanced degrees.

Those trained in the field of agricultural engineering technology are qualified for positions in sales and service of agricultural equipment such as farm machinery, irrigation systems, etc.; as county agents or farmers; and for farm advisory work with such organizations as electric power companies.

## CURRICULUM IN BIOLOGICAL AND AGRICULTURAL ENGINEERING

### SCIENCE PROGRAM

This curriculum, offered in conjunction with the School of Engineering, is designed to develop young people capable of engineering leadership in agriculture. Emphasis is placed on basic science courses such as mathematics, physics, mechanics, biology, soils, and thermodynamics, which provide a sound background for engineering and agricultural technology. Courses in biological and agricultural engineering are directed to those methods of thought and techniques whereby science can be applied with understanding and judgment to engineering situations in agricultural operations. General agriculture courses are provided in order that the student can better understand the agricultural industry with which one deals.

Since biological and agricultural engineering involves two distinct technical fields—agriculture and engineering—this curriculum is a joint responsibility of the two schools and is so administered. Graduates in the program receive the degree of Bachelor of Science in Biological and Agricultural Engineering.

For the freshman year program in agricultural engineering science, refer to the common freshman year in the School of Engineering, page 148.

#### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 202 Analytic Geometry and Calculus III .....	4	MA 301 Applied Differential Equations I ..	3
PY 208 General Physics .....	4	EM 305 Engineering Dynamics .....	3
EM 205 Principles of Engineering Mechanics .....	3	EE 331 Principles of Electrical Engineering .....	3
BAE 251 Elements of Biological & Agricultural Engineering .....	3	BS 100 General Biology .....	4
CSC 111 Algorithmic Languages I .....	2	Social Science & Humanities Elective .....	3
Physical Education .....	1	Physical Education .....	1
	17		17

#### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EM 307 Mechanics of Solids .....	3	BAE 342 Agricultural Processing .....	4
BAE 391 Electrotechnology in Biological & Agricultural Engineering .....	3	BAE 462 Functional Design of Field Machines .....	3
BAE 361 Analytical Methods .....	3	BAE 381 Agricultural Structures & Environment .....	3
MAE 301 Engineering Thermodynamics I ..	3	Social Science & Humanities Elective .....	3
SSC 200 Soils .....	4	Free Elective .....	3
	16		16

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BAE 451 Agricultural Engineering Design I .....	3	BAE 452 Agricultural Engineering Design II .....	3
BAE 472 Agricultural Water Management .....	4	Advised Technical Elective .....	3
Social Science & Humanities Elective .....	6	Free Elective .....	3
Free Elective .....	3	Social Science & Humanities Elective .....	6
	<hr/> 16		<hr/> 15
		Total Hours for Graduation .....	129

Social science and humanities electives will be taken according to the standard engineering school listing.

## CURRICULUM IN BIOLOGICAL AND AGRICULTURAL ENGINEERING

### TECHNOLOGY PROGRAM

This curriculum is designed for those who are working on a practical level with farm people. Graduates are equipped to apply to the farm the new technology as developed and revealed by the research engineer. The courses are presented and directed toward the solution of consumer problems with emphasis on the techniques employed. Graduates from this program will receive the degree of Bachelor of Science in Agriculture.

Listed below are the departmental requirements in the technology program and a typical curriculum in this program.

<i>Departmental Requirements* (26 Credits)</i>		BAE 332 Farm Structures .....	3
BAE 211 Farm Machinery .....	4	BAE 341 Farm Electrification and Utilities .....	3
BAE 303 Energy Conversion for Agricultural Production .....	2	BAE 411 Farm Power and Machinery .....	3
BAE 321 Irrigation, Terracing, and Erosion Control .....	3	BAE 433 Crop Preservation and Processing .....	3
BAE 331 (FS 331) Food Engineering .....	3	E 101 Engineering Graphics I .....	2

## TYPICAL CURRICULUM IN AGRICULTURAL ENGINEERING

### TECHNOLOGY

For the freshman year see page 67.

## SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BAE 211 Farm Machinery .....	4	BAE 341 Farm Electrification & Utilities .....	3
CH 101 General Chemistry I .....	4	CH 103 General Chemistry II .....	4
PY 211 General Physics* .....	4	PY 212 General Physics .....	4
SP 231 Expository Speaking .....	3	SSC 200 Soils .....	4
Physical Education .....	1	Physical Education .....	1
	<hr/> 16		<hr/> 16

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BAE 331 (FS 331) Food Engineering .....	3	BAE 303 Energy Conversion for Agricultural Production .....	2
E 101 Engineering Graphics I .....	2	BAE 321 Irrigation, Terracing & Erosion Control .....	3
Social Science & Humanities Elec. ....	6	Free Elective .....	3
English Elective .....	3	Social Science & Humanities Elec. ....	6
Free Elective .....	3	Group A, B, or C Electives .....	3
	<hr/> 17		<hr/> 17

## SENIOR YEAR

Fall Semester	Credits	Spring Semester	Credits
BAE 433 Crop Preservation & Processing .....	3	BAE 332 Farm Structures .....	3
Free Elective .....	3	BAE 411 Farm Power & Machinery .....	3
Group A, B, or C Elective .....	9	Free Electives .....	3
Social Science & Humanities Elective .....	3	Group A, B, or C Electives .....	6
	18		15
		Total Hours for Graduation .....	130

\* PY 211, 212 will be taken in place of PY 221 as shown in the agricultural technology curriculum. These three additional credits are Group A electives required by the department.

## GRADUATE STUDY

The department offers programs of study for the Master of Science, Doctor of Philosophy and Master of Biological and Agricultural Engineering degrees. Prospective applicants should consult the Graduate School Catalog.

## BIOLOGICAL SCIENCES

Gardner Hall

C. F. LYTLE, *Major Adviser*

The biological sciences curriculum is an interdepartmental program designed to serve the needs of students desiring a comprehensive training in biology rather than specialization in some specific field of the biological sciences. It is especially suitable for students preparing for graduate study in a specialized field of biology as well as for students planning to teach high school biology. Also, students preparing for careers in business or industry and wishing a broad, general training in biology may find the biological sciences curriculum suitable.

Experience has indicated one of the best preparations for graduate study in biology is a broad training in the basic biological sciences supplemented with a strong background in the physical sciences and supporting areas. The biological sciences curriculum incorporates these features and provides the student with maximum flexibility and options for specialization at the graduate level.

Because of its emphasis on a strong preparation in the physical and biological sciences and on preparation for graduate study, the biological sciences curriculum is a rigorous program requiring several courses in chemistry, physics, mathematics and foreign language. Those students whose interests and aptitudes fall primarily in a specific area of the biological sciences should elect one of the departmental majors such as botany, zoology or entomology.

Students wishing to concentrate their studies within a specific field can do so in the biological sciences curriculum by selecting appropriate free and restricted elective courses in consultation with their advisers. Such programs within the biological sciences curriculum are available to provide emphasis in biochemistry, botany, entomology, microbiology, zoology and biology teaching.

## COURSE REQUIREMENTS IN THE BIOLOGICAL SCIENCES CURRICULUM

	Credits		
ALS 103 Orientation .....	1	<i>Physical Sciences and Mathematics</i> (34-36 Credits)	
<i>Languages (12 Credits)</i>		MA 114 Topics in Modern Mathematics ....	3
ENG 111 Composition and Rhetoric .....	3	MA 112 Analytic Geometry and	
ENG 112 Composition and Reading .....	3	Calculus A .....	4
Modern Language (200 level) .....	6	MA 212 Analytic Geometry and	
<i>Social Sciences and Humanities</i> (21 Credits)		Calculus B .....	3
Electives .....		or	
		MA 102 Analytic Geometry and	
	21	Calculus I .....	4

MA 201	Analytic Geometry and Calculus II	4
MA 202	Analytic Geometry and Calculus III	4
CH 101	General Chemistry I	4
CH 107	Principles of Chemistry	4
CH 221	Organic Chemistry I	4
CH 223	Organic Chemistry II	4
PY 211	General Physics	4
PY 212	General Physics	4

*Biological Sciences*  
(31 Credits)

BS 100	General Biology	4
BO 200	Plant Life	4
ZO 201	Animal Life	4
BO 421	Plant Physiology	
or		
ZO 421	Vertebrate Physiology	
or		

BO 414 (ZO 414)	Cell Biology	3-4
MB 401	General Microbiology	4
BCH 351	Elementary Biochemistry	3
BO 360 (ZO 360)	Introduction to Ecology	4
GN 411	The Principles of Genetics	3
GN 412	Elementary Genetics Lab	1

*Electives*  
(25-27 Credits)

Restricted Electives from Groups A, B, C and D	13-15
Free Electives	12
Subtotal	126
Physical Education	4

Total Hours for Graduation 130

## TYPICAL PROGRAMS IN THE BIOLOGICAL SCIENCES CURRICULUM GENERAL

For freshman year see pages 65-66.

### SOPHOMORE

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 112 Analytic Geometry and Calculus A		ZO 201 Animal Life	4
or		CH 223 Organic Chemistry II	4
MA 102 Analytic Geometry and Calculus I	4	Social Science or Humanity Elective	3
BO 200 Plant Life	4	MA 212 Analytic Geometry & Calculus B	
CH 221 Organic Chemistry I	4	or	
Social Science or Humanity Elective	3	MA 201 Analytic Geometry & Calculus II	3-4
Physical Education	1	Physical Education	1
	16		15-16

### JUNIOR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
PY 211 General Physics	4	PY 212 General Physics	4
BO 360 (ZO 360) Introduction to Ecology	4	BCH 351 Elementary Biochemistry	3
Modern Language (200 level)	3	GN 411 The Principles of Genetics	3
Social Science or Humanity Elective	3	GN 412 Elementary Genetics Lab	1
Free Elective	3	Modern Language (200 level)	3
	17	Social Science or Humanity Elective	3
			17

### SENIOR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 421 Plant Physiology		MB 401 General Microbiology	4
or		Free Electives	9
ZO 421 Vertebrate Physiology		Restricted Electives	3
or			16
BO 414 (ZO 414) Cell Biology	3-4		
Social Science or Humanity Elective	3		
Restricted Electives	11-12		
	18-19		
		Total Hours for Graduation	130

## BIOCHEMISTRY EMPHASIS

For a typical curriculum in the biological sciences, biochemistry emphasis, see pages 74-75.

## MICROBIOLOGY EMPHASIS

For freshman year see pages 65-66.

### SOPHOMORE

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Modern Language (200 level) .....	3	Modern Language (200 level) .....	3
BO 200 Plant Life .....	4	ZO 201 Animal Life .....	4
CH 221 Organic Chemistry I .....	4	CH 223 Organic Chemistry II .....	4
MA 202 Analytic Geometry and Calculus III .....	4	BCH 351 Elementary Biochemistry .....	3
Physical Education .....	1	Free Elective .....	3
	16	Physical Education .....	1
			18

### JUNIOR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
PY 211 General Physics .....	4	PY 212 General Physics .....	4
BO 414 (ZO 414) Cell Biology .....	3	GN 411 Principles of Genetics .....	3
BO 360 (ZO 360) Introduction to Ecology ..	4	GN 412 Elementary Genetics Laboratory ..	1
Social Science or Humanities Electives ..	6	MB 401 General Microbiology .....	4
	18	Social Science or Humanity Elective .....	3
			15

### SENIOR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BCH 452 Experimental Biochemistry .....	3	MB 514 Microbiology Metabolism .....	4
MB 501 Advanced Microbiology .....	4	Social Science or Humanity Elective .....	3
Social Science or Humanity Elective .....	3	Free Electives .....	9
Restricted Elective .....	6-7		16
	16-17		
		Total Hours for Graduation .....	130

## TEACHING

For freshman year see pages 65-66.

### SOPHOMORE

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 212 Analytical Geometry .....	3	ZO 201 Animal Life .....	4
Calculus B .....	3	CH 223 Organic Chemistry II .....	4
BO 200 Plant Life .....	4	ED 203 Introduction to Teaching Math and Science* .....	3
CH 221 Organic Chemistry I .....	4	Social Science and Humanities Electives ..	6
PSY 200 Introduction to Psychology .....	3	Physical Education .....	1
Physical Education .....	1		18
	15		

### JUNIOR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
PY 211 General Physics .....	4	PY 212 General Physics .....	4
ED 344 Secondary Education* .....	3	BCH 351 Elementary Biochemistry .....	3
BO (ZO) 360 Introduction to Ecology .....	4	GN 411 Principles of Genetics .....	3
BO (ZO) 414 Cell Biology .....	3	GN 412 Elementary Genetics Lab .....	1
Modern Language (200 level) .....	3	PSY 304 Educational Psychology .....	3
	17	Modern Language (200 level) .....	3
			17

## SENIOR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 420 Principles of Guidance* .....	2	MB 401 General Microbiology .....	4
ED 475 Methods of Teaching Science* .....	3	Restricted Electives .....	8
ED 476 Student Teaching in Science* .....	8	Social Science or Humanity Elective .....	3
ED 477 Developing and Selecting Teaching Materials in Science* .....	2		15
PSY 476 Psychology of Adolescence .....	2		
	17	Total Hours for Graduation .....	130

\* These courses (total of 18 credit hours) must be selected in lieu of certain free and restricted electives to complete requirements for a teaching certificate.

## BOTANY

Gardner Hall

*Professor G. R. NOGGLE, Head of the Department*

*Professors:* A. W. COOPER (on leave), R. J. DOWNS, J. W. HARDIN, A. KROCHMAL (USFS), J. R. TROYER; *Adjunct Professors:* W. W. HECK, J. A. YARBROUGH; *Professors Emeriti:* D. B. ANDERSON, H. T. SCOFIELD, B. W. WELLS, L. A. WHITFORD; *Associate Professors:* C. E. ANDERSON, R. C. FITES, R. T. MOORE, H. E. PATTEE (USDA), H. E. SCHLICHTING JR., H. SELTMANN (USDA), R. E. WILLIAMSON (USDA); *Adjunct Associate Professors:* D. W. DE JONG, H. L. LEWIS; *Assistant Professors:* U. BLUM, S. D. KOCH, E. D. SENECA, C. G. VAN DYKE, A. M. WITHERSPOON; *Instructor:* LINDA M. STROUD; *Associate Members of the Faculty:* J. S. KAHN (Biochemistry), D. E. MORELAND (USDA Crop Science), R. J. THOMAS (Wood and Paper Science), D. H. TIMOTHY (Crop Science, Genetics), B. J. COPELAND (Zoology)

The instructional program in the department provides classroom, laboratory, and field experience in the major areas of plant science. Undergraduates majoring in botany are given a broad background in the humanities and physical sciences, and are encouraged to participate in independent study in their senior year. Majors are prepared for advanced study in botany and other biological fields, as well as in the applied plant sciences such as horticulture, crop science, resource management, pest management and environmental biology.

## OPPORTUNITIES

Many majors in the department elect to continue advanced studies in botany leading to the Master of Life Sciences, Master of Science and Doctor of Philosophy degrees. There is need for persons with training in botany for teaching positions in community and junior colleges, colleges and universities, for research positions in federal and state government laboratories and in private industry.

Recent federal and state legislation has created a need for botanists in environmental quality studies. Positions are open to persons with a Bachelor of Science degree to work in air and water quality control programs, in air pollution and in environmental impact studies. Field botanists and naturalists also are needed in park systems and nature programs.

## UNDERGRADUATE CURRICULUM

The Bachelor of Science degree with a major in botany is offered under the science curriculum of the School of Agriculture and Life Sciences. The program for the freshman year is shown on pages 65-66, and the other basic requirements are listed on pages 66-70.

The Bachelor of Science degree with double concentration—one in economics, English, history, philosophy, politics and another in botany—is available in the School of Liberal Arts. See pages 196-197 for details.

## TYPICAL CURRICULUM IN BOTANY

### SCIENCE PROGRAM

SOPHOMORE YEAR		JUNIOR YEAR	
	<i>Credits</i>		<i>Credits</i>
BO 403 Systematic Botany .....	4	BO 421 Plant Physiology .....	4
CH 101 General Chemistry I .....	4	CH 220 Introductory Organic Chemistry ...	4
CH 103 General Chemistry II .....	4	GN 411 The Principles of Genetics .....	3
Language Electives .....	6	GN 412 Elementary Genetics Laboratory ..	1
Social Science and Humanities Elective ....	3	Social Science and Humanities Electives ...	6
SSC 200 Soils .....	4	PY 221 College Physics .....	5
ZO 201 Animal Life .....	4	Science Elective .....	4
Physical Education .....	2	Electives .....	8
	<hr/> 31		<hr/> 35

### SENIOR YEAR

	<i>Credits</i>
BO 360 (ZO 360) Introduction to Ecology .	4
BO 400 Plant Diversity .....	4
MB 401 General Microbiology .....	4
Social Science and Humanities Electives ....	6
Electives .....	16
	<hr/> 34
Total Hours for Graduation .....	130

## GRADUATE STUDY

The department offers a professional master's program, the Master of Science and Doctor of Philosophy degrees. Those interested in the departmental graduate program should consult the head of the department or the Graduate School catalog.

## CONSERVATION

(Also see forest resources.)

Williams, Gardner and Biltmore Halls

M. G. COOK, *Major Adviser, School of Agriculture and Life Sciences*

L. C. SAYLOR, *Major Adviser, School of Forest Resources*

Conservation is the wise use, preservation or improvement of natural resources, without waste for the long-time benefit of man. This degree program in conservation is offered jointly by the School of Agriculture and Life Sciences and by the School of Forest Resources. Faculty members in botany, entomology, forestry, plant pathology, recreational resources administration, soil science, and wildlife are directly involved in various aspects of education in conservation.

Rapid urbanization and industrialization plus an increase in population are bringing increased pressures on the use of land areas for recreation as well as food, fiber and wood production. These trends create an acute need for people trained to make sound judgments in the management of natural resources.

Conservationists must be able to view problems from several aspects rather than from a narrow vision. This phase of conservation has been called a philosophy

rather than a discipline. However, for the conservationist to apply this philosophy to problem-solving in a modern society, he must be well-trained in the basic concepts of several disciplines.

OPPORTUNITIES

Needed in increasing numbers are conservationists who are trained in the management of (1) wildlands for water, fish and game production, (2) intensively used agricultural and forested areas, and (3) areas of concentrated human habitation.

UNDERGRADUATE CURRICULUM

Students will enroll in either of the two schools depending on the primary area of interest in conservation. The freshman common core of courses for either school is acceptable. All students will take a prescribed core of subjects in conservation. Students desiring a strong background in a particular area may obtain a dual degree by the appropriate use of electives. Specialists in soils, wildlife biology, forest management and other selected areas are developed through the proper choice of courses.

REQUIRED AND ELECTIVE COURSES IN CONSERVATION

<i>Requirements</i>	<i>Credits</i>
FOR 472 Renewable Resource Management . . . . .	3
GY 120 Physical Geology . . . . .	3
RRA 241 Recreation Resource Relationships . . . . .	3
SSC 200 Soils . . . . .	4
ZO 221 Conservation of Natural Resources . . . . .	3
ZO 353 Wildlife Management . . . . .	3
Conservation Electives . . . . .	12
	<hr/> 31

<i>Electives:</i>	
BAE 472 Agricultural Water Management . . . . .	4
BO 403 Systematic Botany . . . . .	4
BO 544 Plant Geography . . . . .	3
FOR 452 Silvics . . . . .	4
FOR 572 Conservation Policy Issues . . . . .	3
GY 208 Environmental Physical Geography . . . . .	3
GY 222 Historical Geology . . . . .	3
MY 201 Atmospheric Environment . . . . .	3
MY 486 Weather and Climate . . . . .	2
RRA 441 Recreation Resource Development . . . . .	3
RRA 442 Wildland Recreation Environments . . . . .	3
SSC 341 Soil Fertility and Fertilizers . . . . .	3
SSC 461 Soil and Water Conservation . . . . .	3
SSC 472 Forest Soils . . . . .	3
ZO 501 Ornithology . . . . .	3
ZO 420 Fishery Science . . . . .	3
ZO 544 Mammalogy . . . . .	3

<i>Biological Science Requirements:</i>	
BS 100 General Biology . . . . .	4
BO 200 Plant Life . . . . .	4
or	
ZO 201 Animal Life . . . . .	4
BO 360 (ZO 360) Introduction to Ecology . . . . .	4
Electives* . . . . .	9
	<hr/> 21

<i>English, Humanity and Social Science Requirements</i>	
ENG 111, ENG 112 Composition and Rhetoric, Reading . . . . .	6
English Electives . . . . .	6
Humanity—Social Science Electives . . . . .	21
	<hr/> 33

<i>Mathematics and Physical Sciences</i>	
CH 101, CH 103 General Chemistry I, II . . . . .	8
MA 111 Algebra and Trigonometry and either	
MA 112 Analytic Geometry and Calculus A or	
MA 102 Analytic Geometry and Calculus I . . . . .	8
PY 221 College Physics . . . . .	5
or	
PY 211, PY 212 General Physics . . . . .	8
ST 311 Introduction to Statistics . . . . .	3
	<hr/> 24-27

Orientation . . . . .	1
Physical Education . . . . .	4
Electives . . . . .	15
	<hr/> 20
Total Hours for Graduation . . . . .	128

\* These biological science electives would vary to meet requirements of different departments; they would include such courses as botany, entomology, genetics, physiology, plant pathology and zoology.

## TYPICAL CURRICULUM IN CONSERVATION

### SCIENCE PROGRAM

For the freshman year see pages 65-66.

#### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 103 General Chemistry II .....	4	BO 200 Plant Life	
GY 120 Physical Geology .....	3	or	
Humanities—Social Sciences Elective .....	3	ZO 201 Animal Life .....	4
ZO 221 Conservation of Natural Resources .....	3	English Elective .....	3
Free Elective .....	3	Humanities—Social Sciences Elective .....	3
Physical Education .....	1	SSC 200 Soils .....	4
	—	Physical Education .....	1
	17		—
			15

#### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 360 (ZO 360) Introduction to Ecology .....	4	Biological Sciences Elective .....	3
Conservation Elective .....	4	Conservation Elective .....	3
FOR 472 Renewable Resource		Humanities—Social Sciences Elective .....	3
Management .....	3	PY 221 College Physics .....	5
Humanities—Social Sciences Elective .....	3	RRA 241 Recreation Resource	
ST 311 Introduction to Statistics .....	3	Relationships .....	3
	—		—
	17		17

#### SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Biological Sciences Elective .....	3	Biological Sciences Elective .....	3
Conservation Elective .....	3	Conservation Elective .....	3
English Elective .....	3	Humanities—Social Sciences Elective .....	3
ZO 353 Wildlife Management .....	3	Free Electives .....	6
Free Electives .....	5		—
	—		15
	17	Total Hours for Graduation .....	128

## CURRICULUM IN CONSERVATION (Wildlife Concentration)

### SCIENCE PROGRAM

For the freshman year pages 65-66.

#### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
English or Language Elective		English or Language Elective .....	3
(Literature) .....	3	Social Science—Humanity Electives .....	6
GY 120 Physical Geology .....	3	SSC 200 Soils .....	4
Free Elective .....	3	ZO 221 Conservation of Natural	
Social Science—Humanity Elective .....	3	Resources .....	3
ZO 201 Animal Life .....	4	Physical Education .....	1
Physical Education .....	1		—
	—		17
	17		

#### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 200 Plant Life .....	4	ST 311 Introduction to Statistics .....	3
PY 221 College Physics .....	5	Social Science or Humanity .....	6
RRA 241 Recreation Resource		ZO 351 Vertebrate Zoology .....	4
Relationships .....	3	Advised Elective .....	4
ZO 360 (BO 360) Introduction to Ecology .....	4		—
	—		17
	16		

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ZO 353 Wildlife Management .....	3	FOR 472 Renewable Resources	
ZO 420 Fishery Science .....	3	Management .....	3
ZO 501 Ornithology .....	3	GN 411 The Principles of Genetics .....	3
Free Electives .....	6	ZO 544 Mammalogy .....	3
	—	Free Electives .....	6
	15		15
		Total Hours for Graduation .....	128

For the student who is interested in conservation and communication, the following courses in communication are available:

AC 311 Communications Methods and Media .....	3
ENG 215 Principles of News and Article Writing .....	3
ENG 321 The Communication of Technical Information .....	3
ENG 496 Literary Analysis (Senior Seminar) .....	3
SP 350 Fundamentals of Radio Broadcasting .....	3

## CROP SCIENCE

Williams Hall

*Professor P. H. HARVEY, Head of the Department*

## TEACHING AND RESEARCH

*Professors:* C. A. BRIM (USDA), D. S. CHAMBLEE, J. F. CHAPLIN (USDA), W. K. COLLINS, W. A. COPE (USDA), D. A. EMERY, D. U. GERSTEL, W. C. GREGORY, H. D. GROSS, G. L. JONES, K. R. KELLER, J. A. LEE (USDA), W. M. LEWIS, T. J. MANN, P. A. MILLER, R. P. MOORE, D. E. MORELAND (USDA), L. L. PHILLIPS, J. C. RICE, D. L. THOMPSON (USDA), D. H. TIMOTHY, J. B. WEBER, E. A. WERNSMAN, J. A. WEYBREW, A. D. WORSHAM; *Adjunct Professor:* W. H. WESSLING; *Professor Emeritus:* G. K. MIDDLETON; *Associate Professors:* J. C. BURNS (USDA), T. H. BUSBICE (USDA), F. T. CORBIN, W. T. FIKE JR., W. B. GILBERT, G. R. GWYNN (USDA), C. F. MURPHY; *Assistant Professors:* R. C. LONG, R. P. PATTERSON, J. W. SCHRADER, C. F. TESTER (USDA), W. W. WEEKS; *Instructors:* D. T. GOODEN III, T. H. NUNALEE III, J. C. WYNNE; *Associate Members of the Faculty:* E. C. SISLER (Biochemistry), T. J. SHEETS (Entomology, Horticultural Science)

## EXTENSION

*Professor G. L. JONES, In Charge of Agronomy Extension*

*Professors:* C. T. BLAKE, S. H. DOBSON, S. N. HAWKS JR., F. W. McLAUGHLIN, A. PERRY, A. D. STUART; *Professors Emeriti:* R. R. BENNETT, *Associate Professors:* H. F. ROSS, W. G. TOOMEY; *Assistant Professors:* J. G. CLAPP JR., H. D. COBLE, E. L. KIMBROUGH; *Assistant Professor Emeritus:* R. H. CROUSE; *Agronomy Specialist:* G. A. SULLIVAN

The rapid increase in human populations, the continuing evolution of pests and diseases, the challenge of new natural and artificial environments and the decrease of farm land are all critical and current world issues.

The curricula in this department are designed to give the crop science major an awareness and a sense of personal involvement in these issues. The student

receives a working knowledge of the fundamental principles of plant science which tend to shape modern crop production practices. He is also trained in the economics of various crop management procedures which may influence long-range investments.

## OPPORTUNITIES

With cash crops returning nearly one billion dollars to the annual farm income of North Carolina, the opportunities within the state for crop science graduates in county extension programs, in farm management, as salesmen of seed and agricultural chemicals and in the several governmental agencies remain good. Demand for qualified students in national and international concerns is increasing.

## UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in crop science is offered under the business and science curricula of the School of Agriculture and Life Sciences. Students may also earn the degree of Bachelor of Science under the technology curriculum with a major in agronomy. The agronomy option is administered jointly by the Departments of Crop Science and Soil Science.

For the freshman year and basic requirements see pages

## CURRICULA IN CROP SCIENCE

### BUSINESS PROGRAM

Refer to pages 66-67.

### SCIENCE PROGRAM

#### *Physical and Biological Sciences*

#### *Credits*

MA 111	Algebra and Trigonometry .....	4
MA 112	Analytic Geometry and Calculus A. .	4
BO 200	Plant Life .....	4

#### *Group A, B, & C Courses (2½ Credits)*

CH 221	Organic Chemistry I .....	4
CH 223	Organic Chemistry II .....	4
GN 411	The Principles of Genetics .....	3
GN 412	Elementary Genetics Laboratory ..	1
MA 114	Topics in Modern Math or	
MA 212	Analytic Geometry and Calculus B. .	3
MB 401	General Microbiology .....	4
PP 315	Plant Diseases .....	3
Electives in A, B, or C Courses .....		2

#### *Departmental Requirements and Electives (27 Credits)*

BO 421	Plant Physiology .....	4
CS 211	Crop Science .....	4
CS 214	Crop Science Laboratory .....	1
CS 311	Field Crop Production or	
CS 312	Pastures and Forage Crops .....	3
CS 414	Weed Science .....	3
CS 490	Senior Seminar in Crop Science ...	1
ENT 312	Introduction to Economic Insects .....	3
SSC 200	Soils .....	4
Soil Science Electives .....		3
Elective .....		1
Total Hours for Graduation .....		130

## CURRICULUM IN AGRONOMY\*

### TECHNOLOGY PROGRAM

#### *Physical and Biological Sciences*

#### *Credits*

BO 421	Plant Physiology .....	4
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#### *Groups A, B & C Courses (19-20 Credits)*

CH 220	Introductory Organic Chemistry ..	4
GN 411	The Principles of Genetics .....	3
PP 315	Plant Diseases .....	3
Electives .....		9 or 10

#### *Departmental Requirements and Electives (28 Credits)*

CS 211	Crop Science .....	4
CS 214	Crop Science Laboratory .....	1
CS 311	Field Crop Production or	
CS 312	Pastures and Forage Crops .....	3
CS 411	Environmental Aspects of Crop Production .....	2

CS 413 Plant Breeding .....	2	SSC 452 Soil Classification .....	3
CS 414 Weed Science .....	3	SSC 461 Soil and Water Conservation .....	3
CS 490 Senior Seminar in Crop Science ...	1	Electives .....	3
SSC 341 Soil Fertility and Fertilizers .....	3	Total Hours for Graduation .....	130

\* The agronomy major is administered by the Departments of Crop Science and Soil Science and is listed jointly. See typical agronomy curriculum under soil science, pages 109-110.

## PLANT PROTECTION

The Departments of Crop Science, Entomology and Plant Pathology offer a joint undergraduate major in plant protection. See the section on plant protection, pages 101-102, for details.

## GRADUATE STUDY

The Department of Crop Science offers a professional master's program, the Master of Science, and the Doctor of Philosophy. Prospective applicants should consult the Graduate School Catalog.

## DAIRY SCIENCE

(See animal science, pages 70-73.)

## ECONOMICS

(Also see liberal arts.)

Patterson Hall

*Professor W. D. TOUSSAINT, Head of the Department*

## TEACHING AND RESEARCH

*Professors:* A. J. BARTLEY, A. J. COUTU, D. M. HOOVER, L. A. IHNEN, G. D. IRWIN (USDA), H. B. JAMES, P. R. JOHNSON, R. A. KING, G. A. MATHIA, B. M. OLSEN, J. A. SEAGRAVES, R. L. SIMMONS, J. G. SUTHERLAND (USDA), C. B. TURNER, T. D. WALLACE, J. C. WILLIAMSON JR.; *Adjunct Professor:* D. R. DIXON; *Professor Emeriti:* J. G. MADDOX, E. W. SWANSON, T. W. WOOD; *Associate Professors:* D. S. BALL, J. S. CHAPPELL, M. M. EL-KAMMASH, E. W. ERICKSON, R. M. FEARN, B. L. GARDNER, C. W. HARRELL JR., E. W. JONES, F. A. MANGUM, E. C. PASOUR JR., R. J. PEELER JR., R. K. PERRIN, R. A. SCHRIMPER, R. E. SYLLA, J. W. WILSON; *Assistant Professors:* J. B. BULLOCK, G. A. CARLSON, W. D. COOPER, L. E. DANIELSON, L. M. ENNIS JR., A. R. GALLANT, H. C. GILLIAM JR., (USDA), T. J. GRENNES, D. L. HOLLEY, D. N. HYMAN, C. P. JONES, J. C. MATTHEWS JR., R. B. MCBURNEY JR., M. B. MCELROY, L. B. PERKINSON (USDA); W. P. PINNA, J. C. POINDEXTER, R. C. REINOSO, H. A. SANDMAN, C. R. SHUMWAY; *Assistant Professor Emeritus:* O. G. THOMPSON; *Instructors:* J. D. ACKER, C. H. BAKER, A. M. BEALS JR., F. V. HARRELL JR., JUDITH M. JEFFERYS, J. S. LAPP, J. H. REEDER, D. H. STUART

## EXTENSION

*Professor F. D. SOBERING, In Charge, Extension Economics*

*Professors:* R. C. BROOKS, G. L. CAPEL, D. G. HARWOOD, T. E. NICHOLS, E. A. PROCTOR, C. R. PUGH, W. L. TURNER, C. R. WEATHERS; *Associate Professors:* J. G. ALLGOOD, R. S. BOAL, R. D. DAHLE, L. H. HAMMOND, H. A. HOMME, H. L.

LINER, D. F. NEUMAN, P. S. STONE, R. C. WELLS; *Assistant Professors*: J. E. IKERD, E. M. STALLINGS, RUBY P. UZZLE; *Instructor*: D. C. PARDUE

Agricultural economics is one of several fields of specialization offered by the Department of Economics. The department is administered jointly by the School of Agriculture and Life Sciences and the School of Liberal Arts. For information on fields of economics other than agricultural see pages 197-200 under the School of Liberal Arts.

The Bachelor of Science degree is offered for undergraduates. Students are given training in all aspects of organizing and operating agricultural business firms. A sound foundation in basic economic principles of production and marketing is provided in order that graduates will be able to deal with the problems associated with rapid changes in technical and economic conditions.

The general objectives of the department, in the area of agricultural economics, are as follows: (1) To train students in the fundamentals of business organization and to make sound decisions in organizing and managing farms and other agricultural businesses; (2) To instruct students in economic theory which may be used as a basis for understanding the relationship of agriculture to other parts of the economy and for the evaluation of agricultural policy and economic changes which affect agriculture; (3) To train graduate students in advanced economic theory and research techniques.

## OPPORTUNITIES

Training in agricultural economics qualifies a student for a wide range of opportunities. The growing number of companies processing and manufacturing agricultural products has created an increasing demand for people trained in agricultural economics. Opportunities include employment by companies handling farm supplies, such as feed, fertilizer and equipment; general marketing and processing firms; agricultural cooperatives; professional farm management agencies, and various credit agencies.

Many graduates of the department are employed in research and educational work by various agencies of the Federal and state governments. These include the Agricultural Extension Service, the Agricultural Experiment Station, the State Department of Agriculture and other agencies of the United States Department of Agriculture.

Greater emphasis on an agribusiness management option and accounting will further stimulate demand for graduates. As industrial and agricultural development continues in North Carolina and other areas, employment opportunities are expected to increase.

## UNDERGRADUATE CURRICULA

Two options are available to undergraduate students majoring in agricultural economics. These curricula options are business and science. Students must meet all of the basic requirements of the University and the School of Agriculture and Life Sciences.

Agricultural science majors are required to meet the science requirements presented on page 66. The student takes MA 212 to provide a stronger base for the quantitative areas of economics and techniques used in economic analysis. He is also required to strengthen his abilities in general areas of economics and business by fulfilling the departmental and Group B requirements and restricted electives of the business curriculum (except for courses in personnel and business management).

In the business program in economics, students receive strong training in economics and business to develop the ability to identify, understand and solve economic problems. The requirements of this program are outlined below.

AGRICULTURAL ECONOMICS

BUSINESS PROGRAM

	Credits
ALS 103 Orientation .....	1
<i>Languages</i> (12 Credits)	
ENG 111 Composition and Rhetoric .....	3
ENG 112 Composition and Reading .....	3
SP 231 Expository Speaking .....	3
Elective (English or Modern Language) .....	3
<i>Social Sciences and Humanities</i> (21 Credits)	
<i>Physical and Biological Sciences</i> (24-25 Credits)	
BS 100 General Biology .....	4
Biological Science Elective .....	4
CH 101 General Chemistry I .....	4
MA 111 Algebra and Trigonometry .....	4
MA 112 Analytic Geometry and Calculus A. 4	
PY 221 College Physics .....	5
<i>Departmental Requirements and Electives</i> (26 Credits)	
EC 301 Production and Prices .....	3
EC 302 National Income and Economic Welfare .....	3
EC 317 Introduction to Methods of Economic Analysis .....	3
or	
ST 311 Introduction to Statistics .....	3
EC 413 Competition, Monopoly, and Public Policy .....	3
or	
EC 533 Agricultural Policy .....	3
Electives in Support of Major .....	14

<i>Electives and Restricted Electives</i> <i>From Groups A, B, and C*</i> (29 or 30 Credits)	
Electives from Groups A and C .....	5 or 6
Group B—Requirements, Restricted Electives, and Electives .....	24
EC 260 Accounting I—Concepts of Financial Reporting .....	3
Business Electives—Group B .....	6
Business Management:	
EC 310 Economics of the Firm .....	3
or	
EC 525 Management Policy and Decision Making	
Finance:	
EC 402 Financial Institutions .....	3
or	
EC 415 Farm Appraisal and Finance or	
EC 420 Corporation Finance	
Marketing:	
EC 311 Agricultural Markets .....	3
or	
EC 411 Marketing Methods or	
EC 521 Markets and Trade	
Personnel:	
EC 426 Personnel Management .....	3
or	
EC 431 Labor Economics or	
EC 432 Industrial Relations	
Production:	
EC 303 Farm Management .....	3
or	
EC 425 Industrial Management or	
EC 551 Agricultural Production Economics	

<i>Other Electives</i> (12 Credits)	
Free Electives .....	12
Subtotal .....	126
Physical Education .....	4
Total Hours for Graduation .....	130**

\* Group A includes the physical and biological sciences; Group B, economics and business management; Group C, applied science and technology; Group D, social sciences and humanities.  
\*\* This curriculum (and the science curriculum) requires the completion of one course in literature.

A typical business program in economics follows. However, it should be emphasized that there is a great deal of flexibility in the agricultural economics major. Approximately 25 percent of the student's total course work is selected by the student in consultation with his major adviser. This flexibility permits each student to develop a strong background in business and economics and at the same time concentrate in a supporting area of major interest such as conservation, crops and soils, economic development, livestock and poultry, or processing of agricultural products. It also facilitates the fulfilling of the requirements for a major in other departments at the same time the degree in agricultural economics is being earned.

For the freshman year see pages 65-66.

# TYPICAL CURRICULUM IN AGRICULTURAL ECONOMICS

## BUSINESS PROGRAM

### SOPHOMORE YEAR

	<i>Credits</i>
ANS 204 Livestock Feeds and Feeding . . . . .	3
CS 211 Crop Science . . . . .	3
Social Science and Humanities Elective . . . . .	3
Social Science and Humanities Elective . . . . .	3
GN 301 Genetics in Human Affairs . . . . .	3
HS 201 Principles of Horticulture . . . . .	3
Social Science and Humanities Elective . . . . .	3
PY 221 College Physics . . . . .	5
Social Science and Humanities Elective . . . . .	3
SP 231 Expository Speaking . . . . .	3
Physical Education . . . . .	2
	—
	34

### JUNIOR YEAR

	<i>Credits</i>
EC 301 Production and Prices . . . . .	3
EC 302 National Income and Economic Welfare . . . . .	3
EC 303 Farm Management . . . . .	3
EC 311 Agricultural Markets . . . . .	3
EC 260 Accounting I—Concepts of Financial Reporting . . . . .	3
EC 415 Farm Appraisal and Finance . . . . .	3
EC 431 Labor Economics . . . . .	3
ENG 265 American Literature I (Beginnings to 1850) . . . . .	3
ST 311 Introduction to Statistics . . . . .	3
ZO 201 Animal Life . . . . .	4
Free Elective . . . . .	3
	—
	34

### SENIOR YEAR

	<i>Credits</i>
EC 407 Business Law I . . . . .	3
EC 430 Agricultural Price Analysis . . . . .	3
EC 440 Economic Development . . . . .	3
EC 523 Planning Farm and Area Adjustments . . . . .	3
EC 525 Management Policy and Decision Making . . . . .	3
EC 533 Agricultural Policy . . . . .	3
EC 551 Agricultural Production Economics . . . . .	3
Social Science and Humanities Elective . . . . .	3
Free Electives . . . . .	7
	—
	31
Total Hours for Graduation . . . . .	130

## GRADUATE STUDY

The Master of Economics, Master of Arts in economics and Master of Science in agricultural economics degrees are available as well as the Doctor of Philosophy degree with a specialization in agricultural economics. Prospective applicants should consult the Graduate School Catalog.

## ENTOMOLOGY

Gardner Hall

*Professor* KENNETH L. KNIGHT, *Head of the Department*

## TEACHING AND RESEARCH

*Professors:* R. C. AXTELL, C. H. BRETT, W. V. CAMPBELL, W. C. DAUTERMAN, M. H. FARRIER, F. E. GUTHRIE, ERNEST HODGSON, W. J. MISTRIC JR., H. H. NEUNZIG, R. L. RABB, T. J. SHEETS, C. F. SMITH, D. A. YOUNG JR.; *Adjunct Professors:* LAWRENCE FISHBEIN, J. R. FOUTS, LOUISE M. RUSSELL, C. W. SABROSKY, R. I. SAILER; *Professor Emeritus:* T. B. MITCHELL; *Associate Professors:* J. R. BRADLEY, W. M. BROOKS, H. B. MOORE JR., G. C. ROCK, C. G. WRIGHT, R. T. YAMAMOTO; *Adjunct Associate Professor:* A. L. CHASSON

EXTENSION

Professor: G. T. WEEKMAN, *Specialist in Charge*

Professor: R. L. ROBERTSON; *Professor Emeritus*: G. D. JONES; *Associate Professors*: J. M. FALTER, H. E. SCOTT, F. E. WHITFIELD; *Assistant Professors*: J. R. BAKER, K. A. SORENSEN

The entomology curriculum offers broad training at both the undergraduate and graduate levels in basic biology and related sciences, particularly as they relate to the study of insects. In addition, introductory and terminal courses in insect control technology are offered at the undergraduate level for students majoring in other areas.

OPPORTUNITIES

Opportunities for careers in entomology are plentiful and varied. Research positions are available in many universities and colleges as well as with federal and state government and private industry. The needs for college teachers are also great. Other opportunities include development, production, control and sales positions in the pesticide field and regulatory and extension positions with state and federal agencies.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in entomology is offered under the science curriculum of the School of Agriculture and Life Sciences. Students are also encouraged to major in biological sciences and devote their electives to entomology courses.

For the freshman year and basic requirements see pages 65-70.

CURRICULUM IN ENTOMOLOGY

SCIENCE PROGRAM

<i>Group A Courses</i> <i>(25-26 Credits)</i>		
BCH 351	Elementary Biochemistry or equivalent .....	3
BO 421	Plant Physiology or .....	
ZO 421	Vertebrate Physiology .....	3
GN 411	The Principles of Genetics .....	3
GY 120	Physical Geology .....	3
	or .....	
SSC 200	Soils .....	4
MB 401	General Microbiology .....	4
ST 311	Introduction to Statistics .....	3
Electives*	.....	5

<i>Departmental Requirements and Electives</i> <i>(26 Credits)</i>		
ENT 301	Introduction to Forest Insects or .....	
ENT 312	Introduction to Economic Insects .....	3
ENT 401	(ZO 401) Bibliographic Research in Biology .....	1
ENT 502	Insect Diversity .....	4
ENT 503	Functional Systems of Insects ...	4
Advised Electives	.....	14

\* May be taken from Groups B and C.

## TYPICAL CURRICULUM IN ENTOMOLOGY

For the freshman year, see pages 65-66.

### SOPHOMORE YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
CH 101 General Chemistry I .....	4	CH 103 General Chemistry II .....	4
Literature Elective .....	3	or	
Social Science & Humanities Elective .....	3	CH 107 Principles of Chemistry .....	4
GY 120 Physical Geology .....	3	English or Modern Language Elective .....	3
or		Social Science & Humanities Elective .....	3
SSC 200 Soils .....	4	ENT 312 Introduction to Economic	
Physical Education .....	1	Insects .....	3
Advised Elective .....	3	Free Elective .....	3
		Physical Education .....	1
	17-18		17

### JUNIOR YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
PY 221 College Physics .....	5	BCH 351 Elementary Biochemistry .....	3
CH 220 Introductory Organic Chemistry ..	4	ST 311 Introduction to Statistics .....	3
ZO 421 Vertebrate Physiology .....	3	GN 411 Principles of Genetics .....	3
Social Science & Humanities Elective .....	3	Social Science & Humanities Elective .....	3
	15	Free Elective .....	3
			15

### SENIOR YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
ENT 502 Insect Diversity .....	4	ENT 503 Functional Systems of Insects ...	4
ENT 401 Bibliographic Research in		MB 401 General Microbiology .....	4
Biology .....	1	Free Elective .....	3
Social Science & Humanities Elective .....	3	Advised Electives .....	6
Free Elective .....	3		17
Advised Electives .....	7	Total Hours for Graduation .....	130
	18		

## PLANT PROTECTION

The Departments of Crop Science, Entomology and Plant Pathology offer a joint major in plant protection. See section on plant protection, pages 101-102 for details.

## GRADUATE STUDY

The Master of Science and Doctor of Philosophy degrees and a professional master's program are offered in entomology. Prospective applicants should consult the Graduate School Catalog.

## FOOD SCIENCE

Schaub Food Science Building

*Professor W. M. ROBERTS, Head of the Department*

## TEACHING AND RESEARCH

*Professors:* L. W. AURAND, T. A. BELL (USDA), T. N. BLUMER, H. B. CRAIG, J. L. ETCHHELLS (USDA), M. W. HOOVER, A. E. PURCELL (USDA), M. L. SPECK, H. E.

SWAISGOOD, F. G. WARREN; *Professor Emeritus*: I. D. JONES; *Associate Professors*: D. E. CARROLL JR., H. P. FLEMING (USDA), S. E. GILLILAND, D. D. HAMANN, V. A. JONES, W. M. WALTER JR. (USDA), N. B. WEBB; *Assistant Professors*: D. M. ADAMS JR., H. R. BALL JR., G. G. GIDDINGS, A. P. HANSEN, B. R. JOHNSON; *Adjunct Assistant Professor*: W. Y. COBB

**EXTENSION**

*Professors*: J. A. CHRISTIAN, ELOISE COFER, M. E. GREGORY, F. B. THOMAS, *Associate Professors*: N. C. MILLER JR., F. R. TARVER JR.; *Assistant Professor*: MARY K. HEAD; *Specialist*: R. E. CARAWAN, T. M. MILLER

The Department of Food Science provides undergraduate and graduate programs for the application and coordination of the physical and biological sciences, economics and engineering to the development, processing, packaging, quality control, distribution and utilization of foods.

The department maintains modern and fully equipped laboratories for teaching and research programs in food microbiology and fermentation, food chemistry, food engineering and dairy, fruit, meat, poultry, seafood and vegetable products.

**OPPORTUNITIES**

The increasing consumer demands for greater varieties and quantities of highly nutritious and convenience foods of uniformly high quality create many and varied career opportunities in the food and allied industries for qualified personnel.

Specific career opportunities in the food industries are: management, research and development, process supervision, quality control, procurement, distribution, sales and merchandising. Career opportunities include sales and services in allied industries, consulting and trade association activities and promotional and educational services.

Food science graduates hold teaching, research and extension positions with colleges and universities. Many governmental agencies employ food scientists whose work is directed toward research, regulatory control and the development of food standards.

**UNDERGRADUATE CURRICULUM**

The degree of Bachelor of Science with a major in food science is offered under the science or technology curriculum of the School of Agriculture and Life Sciences

**CURRICULA IN FOOD SCIENCE**

**SCIENCE OR TECHNOLOGY PROGRAM**

<i>Departmental Requirements and Electives</i>	
<i>(26 Credits)</i>	
FS 201 Food Science and Technology	3
FS 331 (BAE 331) Food Engineering	3
FS 402 Food Chemistry	3
FS 405 (MB 405) Food Microbiology	3
Departmental Electives	14

## SCIENCE PROGRAM

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ALS 103 Orientation .....	1	MA 112 Analytic Geometry and Calculus A .....	4
MA 111 Algebra and Trigonometry .....	4	ENG 112 Composition and Reading .....	3
ENG 111 Composition and Rhetoric .....	3	CH 107 Principles of Chemistry .....	4
CH 101 General Chemistry I .....	4	BS 100 General Biology .....	4
Social Science and Humanities Elective ....	3	Physical Education .....	1
Physical Education .....	1		
	<hr/> 16		<hr/> 16

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 212 Analytic Geometry and Calculus B .....	3	CH 223 Organic Chemistry II .....	4
CH 221 Organic Chemistry I .....	4	PY 212 General Physics .....	4
FS 201 Food Science and Technology .....	3	MB 401 General Microbiology .....	4
PY 211 General Physics .....	4	Literature Elective .....	3
Social Science and Humanities Elective ....	3	Physical Education .....	1
Physical Education .....	1		
	<hr/> 18		<hr/> 16

### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
FS 331 (BAE 331) Food Engineering .....	3	Food Science Elective .....	3
FS 402 Food Chemistry .....	3	Group A Electives .....	6
FS 405 (MB 405) Food Microbiology .....	3	Social Science and Humanities Electives ....	6
Language Elective .....	3	Free Elective .....	3
Free Elective .....	3		
	<hr/> 15		<hr/> 18

### SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Food Science Electives .....	6	Food Science Electives .....	5
Group A Elective .....	2	Group A Electives .....	3
Social Science and Humanities Electives ....	6	Social Science and Humanities Elective ....	3
Free Elective .....	3	Free Elective .....	3
	<hr/> 17		<hr/> 14
		Total Hours for Graduation .....	130

## TECHNOLOGY PROGRAM

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ALS 103 Orientation .....	1	MA 112 Analytic Geometry and Calculus A .....	4
MA 111 Algebra and Trigonometry .....	4	ENG 112 Composition and Reading .....	3
ENG 111 Composition and Rhetoric .....	3	CH 103 General Chemistry II or	
CH 101 General Chemistry I .....	4	CH 107 Principles of Chemistry .....	4
Social Science and Humanities Elective ....	3	BS 100 General Biology .....	4
Physical Education .....	1	Physical Education .....	1
	<hr/> 16		<hr/> 16

## SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 114 Topics in Modern Mathematics ....	3	CH 223 Organic Chemistry II	
CH 221 Organic Chemistry I		or	
or		CH 315 Quantitative Analysis .....	4
CH 220 Introductory Organic Chemistry ...	4	PY 221 College Physics .....	5
FS 201 Food Science and Technology .....	3	MB 401 General Microbiology .....	4
Social Science and Humanities Electives ....	6	Literature Elective .....	3
Physical Education .....	1	Physical Education .....	1
	<hr/> 17		<hr/> 17

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
FS 331 (BAE 331) Food Engineering ....	3	Food Science Elective .....	3
FS 402 Food Chemistry .....	3	SP 231 Expository Speaking .....	3
FS 405 (MB 405) Food Microbiology ....	3	Social Science and Humanities Elective ....	3
Social Science and Humanities Elective ....	3	Group A, B, or C Electives .....	6
Free Elective .....	3	Free Elective .....	3
	<hr/> 15		<hr/> 18

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Food Science Electives .....	6	Food Science Electives .....	6
Social Science and Humanities Elective ....	3	Social Science and Humanities Elective ....	3
Group A, B, or C Elective .....	3	Group A, B, or C Electives .....	4
Free Elective .....	3	Free Elective .....	3
	<hr/> 15		<hr/> 16
		Total Hours for Graduation .....	130

## GRADUATE STUDY

The Department of Food Science offers the Master of Science and Doctor of Philosophy degrees and a professional master's program. Prospective applicants should consult the Graduate School Catalog.

## GENETICS

Gardner Hall

*Professor T. J. MANN, Head of the Department*

*Professors:* C. H. BOSTIAN, D. S. GROSCHE, W. D. HANSON, C. S. LEVINGS III, D. F. MATZINGER, L. E. METTLER, R. H. MOLL, T. MUKAI, G. NAMKOONG (USFS), L. C. SAYLOR, B. W. SMITH, S. G. STEPHENS, A. C. TRIANTAPHYLLOU; *Associate Professors:* L. G. BURK (USDA), W. E. KLOOS, H. E. SCHAFFER, C. W. STUBER (USDA); *Assistant Professor:* F. M. JOHNSON; *Instructor:* W. H. MCKENZIE; *Associate Geneticist:* M. P. GREGORY; *Associate Members of the Faculty:* E. U. DILLARD, E. J. EISEN, J. E. LEGATES, O. W. ROBISON (Animal Science); F. B. ARMSTRONG (Biochemistry and Microbiology); C. A. BRIM, J. F. CHAPLIN (USDA), W. A. COPE (USDA), D. A. EMERY, D. U. GERSTEL, W. C. GREGORY, G. R. GWYNN (USDA), P. H. HARVEY, J. A. LEE, P. A. MILLER, C. F. MURPHY, L. L. PHILLIPS, C. F. TESTER (USDA), D. L. THOMPSON (USDA), D. H. TIMOTHY, E. A. WERNSMAN (Crop Science); C. C. COCKERHAM, M. M. GOODMAN, J. O. RAWLINGS (Statistics); J. W. DUFFIELD, T. O. PERRY, B. J. ZOBEL (Forestry); F. D. COCHRAN, G. J. GALLETTA, F. L. HAYNES JR., (Horticultural Science); J. L. APPLE, T. T. HEBERT, N. T. POWELL (Plant Pathology); W. L. BLOW, E. W. GLAZENER, G. A. MARTIN (Poultry Science)

The genetics faculty offers instruction at advanced undergraduate and graduate levels. The undergraduate courses are designed to support other departments of the institution, giving students a background in the science of genetics. The graduate program is designed to train scientists for research and teaching careers in basic genetics and in its application in plant and animal breeding.

## UNDERGRADUATE CURRICULUM

There is no program leading to the Bachelor of Science degree. Undergraduates are encouraged to pursue a program in the biological sciences.

## GRADUATE STUDY

The Department of Genetics offers the Master of Science and the Doctor of Philosophy degrees and a professional master's program. Prospective applicants should consult the Graduate School Catalog.

## HORTICULTURAL SCIENCE

Kilgore Hall

*Professor C. W. DONOHO JR., Head of the Department*

## TEACHING AND RESEARCH

*Professors:* W. E. BALLINGER, F. D. COCHRAN, G. J. GALLETTA, F. L. HAYNES JR., L. J. KUSHMAN (USDA), R. A. LARSON, C. H. MILLER, D. T. POPE, R. L. SAWYER (Peru); *Professors Emeriti:* M. E. GARDNER, J. M. JENKINS JR., G. O. RANDALL; *Associate Professors:* T. F. CANNON, F. E. CORRELL, R. G. HALFACRE, W. R. HENDERSON, T. R. KONSLEDER, R. L. LOWER, P. V. NELSON, W. B. NESBITT, D. C. ZEIGER; *Assistant Professors:* L. K. HAMMETT, T. J. MONACO, D. M. PHARR, C. R. UNRATH; *Instructors:* R. M. SOUTHALL, V. H. UNDERWOOD; *Associate Members of the Faculty:* R. J. DOWNS (Botany); R. H. MOLL (Genetics); T. J. SHEETS (Entomology, Crop Science); R. AYCOCK (Plant Pathology); R. J. VOLK (Soils)

## EXTENSION

*Professor A. A. BANADYGA In Charge*

*Professors:* H. M. COVINGTON, M. H. KOLBE, J. W. LOVE; *Professor Emeritus:* J. H. HARRIS; *Associate Professors:* J. F. BROOKS, C. M. MAINLAND, W. A. SKROCH, H. J. SMITH; *Assistant Professors:* G. R. HUGHES, W. W. REID, D. C. SANDERS, R. L. SPANGLER

The undergraduate programs in horticultural science offer broad training in the physical and biological sciences and business as well as a sound cultural background. Students are prepared for graduate study or for diverse professional service in the fruit and vegetable crops field, in floriculture and in nursery management and landscape horticulture.

The varied climatic conditions in North Carolina make possible the production of a wide variety of horticultural crops on a commercial scale, as well as in parks and gardens. While these crops now represent an important segment of agriculture in North Carolina, further expansion will be realized with the development of adapted varieties, mechanization and intensification of cultural practices, improvement of handling and marketing methods and the development of the food processing industry.

OPPORTUNITIES

Graduates in horticulture will find opportunities in a wide variety of positions in production, processing, sales and service. Among these are county extension agents; vocational agricultural teachers; landscaping and landscape contracting; farm operators; orchard, nursery, greenhouse and flower shop managers; research, production and promotional specialists with commercial seed, floral, fertilizer, chemical and food companies; inspectors and quality control technologists; USDA specialists and as leaders in other phases of agricultural and industrial developments. In addition, the student may prepare himself for one of the many opportunities for graduate study.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in horticultural science can be earned in one of the three curricula—business, science, or technology—offered by the School of Agriculture and Life Sciences. Under these curricula, specialized training is offered for horticultural science majors in fruit and vegetable crops, and in floriculture, nursery management and landscape horticulture.

For the freshman year and basic requirements see pages 65-70.

For the business curriculum see pages 66-67.

TYPICAL CURRICULA IN HORTICULTURAL SCIENCE

SCIENCE PROGRAM

SOPHOMORE YEAR

		<i>Credits</i>		
		<i>FV*</i>	<i>OH*</i>	<i>F*</i>
BO 200	Plant Life .....	4	4	4
CH 103	General Chemistry II .....	4	4	4
CH 220	Introductory Organic Chemistry .....	4	4	4
HS 211, HS 212	Ornamental Plants .....		6	6
HS 301	Plant Propagation .....		3	3
PY 221	College Physics .....	5	5	5
Social Science and Humanities Electives .....		9		
SSC 200	Soils .....	4	4	4
Elective .....		3	3	3
Physical Education .....		2	2	2
		35	35	35

JUNIOR YEAR

		<i>Credits</i>		
		<i>FV*</i>	<i>OH*</i>	<i>F*</i>
BO 421	Plant Physiology .....	4	4	4
ENT 312	Introduction to Economic Insects .....	3	3	3
GN 411	The Principles of Genetics .....	3	3	3
GN 412	Elementary Genetics Laboratory .....	1	1	1
MB 401	General Microbiology .....	4	4	4
Modern Language or English Elective .....		6	6	6
PP 315	Plant Diseases .....	3	3	3
Social Science and Humanities Elective .....		3		
SSC 341	Soil Fertility and Fertilizers .....		3	3
Free Electives .....		6	6	6
		33	33	33

# SENIOR YEAR

	<i>FV*</i>	<i>Credits OH*</i>	<i>F*</i>
HS 411 Nursery Management .....		3	
HS 421 Fruit Production .....	3		
HS 432 Vegetable Production .....	3		
HS 441, HS 442 Floriculture I, II .....			6
HS 471 Arboriculture .....		3	
HS 491 Senior Seminar in Horticultural Science .....	1	1	1
HS 562 (FS 562) Post-Harvest Physiology .....	3		
Social Science and Humanities Electives .....	3	15	15
Advised Electives .....	15	6	6
Free Electives .....	3	3	3
	<hr/>	<hr/>	<hr/>
	31	31	31
Total Hours for Graduation .....			130

\* FV—Fruits and Vegetables

OH—Ornamental and Landscape Horticulture

F—Floriculture

## TYPICAL CURRICULA IN HORTICULTURAL SCIENCE TECHNOLOGY PROGRAM

### SOPHOMORE YEAR

	<i>FV*</i>	<i>Credits OH*</i>	<i>F*</i>
BO 200 Plant Life .....	4	4	4
CH 103 General Chemistry II .....	4	4	4
EC 205 Economic Activity .....	3	3	3
HS 211, 212 Ornamental Plants .....		6	6
HS 301 Plant Propagation .....	3	3	3
PY 221 College Physics .....	5	5	5
SP 231 Expository Speaking .....	3	3	3
Social Science and Humanities Electives .....	6		
SSC 200 Soils .....	4	4	4
Physical Education .....	2	2	2
	<hr/>	<hr/>	<hr/>
	34	34	34

### JUNIOR YEAR

	<i>FV*</i>	<i>Credits OH*</i>	<i>F*</i>
BO 421 Plant Physiology .....	4	4	4
EC 212 Economics of Agriculture .....	3	3	3
ENT 312 Introduction to Economic Insects .....	3	3	3
GN 411 The Principles of Genetics .....	3	3	3
GN 412 Elementary Genetics Laboratory .....	1	1	1
HS 414 Residential Landscaping .....		4	
Modern Language or English Elective .....	3		3
PP 315 Plant Diseases .....	3	3	3
SOC 202 Principles of Sociology .....	3	3	3
SSC 341 Soil Fertility and Fertilizers .....	3	3	3
Free Elective .....	6	6	6
	<hr/>	<hr/>	<hr/>
	32	33	32

### SENIOR YEAR

	<i>FV*</i>	<i>Credits OH*</i>	<i>F*</i>
HS 411 Nursery Management .....		3	
HS 421 Fruit Production .....	3		
HS 432 Vegetable Production .....	3		
HS 441, 442 Floriculture I, II .....			6
HS 471 Arboriculture .....		3	
HS 491 Senior Seminar in Horticultural Science .....	1	1	1
HS 562 (FS 562) Post-Harvest Physiology .....	3		
Modern Language or English Elective .....		3	
Social Science and Humanities Electives .....		6	6
Departmental Elective .....	14	8	11
Technical Elective .....	3	3	3
Free Elective .....	6	6	6
	<hr/>	<hr/>	<hr/>
	33	33	33
Total Hours for Graduation .....			130

\* FV—Fruits and Vegetables

OH—Ornamental and Landscape Horticulture

F—Floriculture

## GRADUATE STUDY

Graduate study under the direction of the horticultural science faculty may enable the student to qualify for the Master of Science or the Doctor of Philosophy degrees. Areas of study and research include plant physiology, plant breeding and genetics, post-harvest physiology, plant nutrition, growth regulators and weed science involving all horticultural crops. The professional degrees can be earned by students who do not plan further graduate study and want to substitute additional course work for the research requirement in their graduate program. Cooperative Master of Science and Doctor of Philosophy degree programs can be arranged with the Departments of Botany, Food Science, Genetics and Soil Science. Prospective students should consult the Graduate School Catalog.

## MEDICAL TECHNOLOGY

Gardner Hall

G. C. MILLER, *Major Adviser*

North Carolina State University has two parallel programs in medical technology. The first program consists of a four-year curriculum with a Bachelor of Science in Zoology followed by a year of training in a hospital laboratory school.

The second program is designed to be completed in four calendar years. The student takes a prescribed curriculum for three years at North Carolina State University. The fourth year consists of a 12-month course in medical technology at the University of North Carolina at Chapel Hill or other approved institutions. At the completion of this phase, a Bachelor of Science degree will be granted from North Carolina State University and a certificate in medical technology from the approved institution. (See zoology pages 110-114.)

## MICROBIOLOGY

Gardner Hall

*Professor J. B. EVANS, Head of the Department*

*Professors:* W. J. DOBROGOSZ, G. H. ELKAN, P. B. HAMILTON, J. J. PERRY; *Adjunct Associate Professors:* H. L. LEWIS, J. J. TULIS; *Assistant Professor:* E. C. HAYES III; *Associate Members of the Faculty:* J. G. LECCE, J. J. MCNEILL (Animal Science); F. B. ARMSTRONG (Biochemistry and Genetics); J. L. ETHELLE, M. L. SPECK (Food Science); W. E. KLOOS (Genetics); W. V. BARTHOLOMEW (Soil Science)

The program in microbiology is designed to provide basic preparation for professional microbiologists, a background in microbiology for students in the other biological sciences, and an awareness of the microbial world as it relates to our daily lives for students in the liberal arts and other areas outside the biological sciences.

Microbiology is concerned with the growth and development, physiology, classification, ecology, genetics and other aspects of the life processes of an array of tiny, generally single-celled, organisms. These organisms may serve as model systems for elucidation of fundamental processes that are common to all living cells. Most of the major discoveries that have produced the spectacular advances in biology during the past decade have resulted from studies of microbial systems. Future developments in the realm of environmental quality and pollution control will rely heavily on an understanding of microbial processes of biodegradation and assimilation.

## OPPORTUNITIES

There are numerous career opportunities for microbiologists in research laboratories, diagnostic and control laboratories, teaching, and technical sales and service positions.

## UNDERGRADUATE CURRICULUM

Although sufficient courses are offered to provide an undergraduate major, students with a primary interest in microbiology are advised to take the biological sciences curriculum (see pages 78-81) and to devote their electives to biochemistry, chemistry, mathematics and microbiology. Generally as few as 12 credits in microbiology may be recommended. However, if a student does not plan to go beyond the Bachelor of Science level, and desires to qualify for registration or a civil service position as a microbiologist, 20 credits in microbiology should be taken.

## GRADUATE STUDY

The department offers programs leading to both the Master of Science and the Doctor of Philosophy degrees in microbiology as well as a professional master's program. Prospective applicants should consult the Graduate School Catalog.

## PLANT PATHOLOGY

Gardner Hall

*Professor D. E. ELLIS, Head of the Department*

## TEACHING AND RESEARCH

*Professors:* J. L. APPLE, R. AYCOCK, K. R. BARKER, C. N. CLAYTON, E. B. COWLING, E. ECHANDI, T. T. HEBERT, C. S. HODGES JR. (USDA), D. M. KLINE (USDA), G. B. LUCAS, L. W. NIELSEN, C. J. NUSBAUM, N. T. POWELL, J. P. ROSS, (USDA), J. N. SASSER, D. L. STRIDER, HEDWIG H. TRIANTAPHYLLOU, N. N. WINSTEAD; *Professor Emeriti:* S. G. LEHMAN, F. L. WELLMAN; *Adjunct Professor:* G. H. HEPTING; *Associate Professors:* G. V. GOODING JR., L. F. GRAND, D. HUISINGH, S. F. JENKINS JR., M. P. LEVI, R. D. MILHOLLAND, H. W. SPURR JR., (USDA); *Adjunct Associate Professors:* E. R. FRENCH, J. W. KOENIGS, E. G. KUHLMAN, R. A. REINERT; *Assistant Professors:* M. K. BEUTE, K. J. LEONARD (USDA), L. T. LUCAS, C. E. MAIN, R. E. WELTY (USDA), C. G. VAN DYKE; *Adjunct Assistant Professors:* A. S. HEAGLE, N. A. LAPP, R. W. PERO, R. G. WILLOUR

## EXTENSION

*Associate Professor H. E. DUNCAN, In Charge*

*Professors:* F. A. TODD, J. C. WELLS; *Professor Emeritus:* H. R. GARRISS; *Associate Professor:* C. W. AVERRE III; *Assistant Professors:* R. K. JONES, P. B. SHOEMAKER, J. H. WILSON JR.; *Extension Instructor:* C. K. BATTEN

Undergraduate instruction in plant pathology is designed to provide introductory and advanced courses on the nature and control of plant diseases to students majoring in crop science, horticultural science, plant protection, agricultural education and forestry. It can also provide students with the fundamental training necessary for graduate study in plant pathology.

## OPPORTUNITIES

Many opportunities for employment in research, extension and teaching are available to graduates with advanced degrees in the field of plant pathology. Openings are available for qualified persons in research in the USDA, state experiment stations and in industry. The rapid development of agricultural chemicals and other methods for disease control offers numerous opportunities. (See plant protection curriculum.)

## UNDERGRADUATE CURRICULUM

The Department of Plant Pathology cooperates in the training of plant protection majors, but does not offer a major in plant pathology at the undergraduate level.

## GRADUATE STUDY

The Department of Plant Pathology offers graduate training in all phases of plant pathology leading to the degrees of Master of Science and Doctor of Philosophy as well as a professional master's program.

## PLANT PROTECTION

Williams and Gardner Halls

N. T. POWELL, *Major Adviser, Department of Plant Pathology*

D. A. EMERY, *Major Adviser, Department of Crop Science*

F. E. GUTHRIE, *Major Adviser, Department of Entomology*

Plant protection is a joint major in the Departments of Entomology, Crop Science and Plant Pathology.

Students in plant protection will be trained in the application of chemical and biological principles for the control of plant diseases, insects and weeds. Crop losses from insects, weeds and diseases for the past several years have been estimated in excess of 10 billion dollars annually in the United States. A knowledge of the organisms to be controlled, the products to be used and the crops to be grown is basic to any control or regulatory program.

## OPPORTUNITIES

Opportunities in plant protection basically involve improving farm efficiency to meet our ever-growing need for food and fiber. About 340 chemical companies are concerned with manufacturing and formulating products for pest control. Technically trained persons are needed for sales development and promotion of agricultural chemicals. Graduates are also trained to fill positions as county extension agents or as state and federal regulatory agents. This major is primarily intended for the Bachelor of Science degree. However, qualified students can go on to graduate school from this curriculum.

## UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in plant protection is offered under the agricultural science curriculum of the School of Agriculture and Life Sciences.

For the freshman year and basic requirements see pages 65-70.

# CURRICULUM IN PLANT PROTECTION

## SCIENCE PROGRAM

*Restricted Electives from Group A  
(26 Credits)*

	<i>Credits</i>
BO 421 Plant Physiology .....	4
CH 220 and BCH 351 Introductory Organic Chemistry, Elementary Biochemistry .....	7
or	
CH 221 and CH 223 Organic Chemistry I, Organic Chemistry II .....	8
GN 411 The Principles of Genetics .....	3
MB 401 General Microbiology .....	4
SSC 200 Soils .....	4
Electives from Group A, B or C .....	3 or 4

*Major Requirements  
(25 Credits)*

BO 200 Plant Life .....	4
CS 211 Crop Science .....	4
CS 414 Weed Science .....	3
ENT 312 Introduction to Economic Insects .....	3
ENT 550 Fundamentals of Insect Control ..	3
PP 315 Plant Diseases .....	3
PP 500 Plant Disease Control .....	3
ZO 201 Animal Life .....	4
Advised Electives .....	4

## TYPICAL CURRICULUM IN PLANT PROTECTION

For the freshman year see pages 65-66.

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
BO 200 Plant Life .....	4	CH 103 General Chemistry II or	
CH 101 General Chemistry I .....	4	CH 107 Principles of Chemistry .....	4
or		ENT 312 Introduction to Economic Insects .....	3
CH 105 Chemistry—Principles and Applications .....	3	Modern Languages or English Elective ..	3
CS 211 Crop Science .....	4	PY 221 College Physics .....	5
Modern Language or English Elective ..	3	Physical Education .....	1
Social Science and Humanities Elective ..	3		16
Physical Education .....	1		
	18-19		

### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 220 Introductory Organic Chemistry or		BO 421 Plant Physiology .....	4
CH 221 Organic Chemistry I .....	4	BCH 351 Elementary Biochemistry .....	3
PP 315 Plant Diseases .....	3	or	
SSC 200 Soils .....	4	CH 223 Organic Chemistry II .....	4
Social Science and Humanities Elective ..	3	GN 411 The Principles of Genetics .....	3
Electives .....	3	GN 412 Elementary Genetics Laboratory ..	1
	17	Social Science and Humanities Elective ..	3
		Electives .....	3
			17 or 18

### SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CS 414 Weed Science .....	3	MB 401 General Microbiology .....	4
ENT 551 Fundamentals of Insect Control ..	3	PP 500 Plant Disease Control .....	3
Phys., Bio. or Business or Tech. Elective .....	3	Physical or Biological Elective .....	2 or 3
Social Science and Humanities Elective ..	3	Social Science and Humanities Elective ..	3
Elective .....	3	Elective .....	3
	15		15 or 16
		Total Hours for Graduation .....	130

## POULTRY SCIENCE

Scott Hall

*Professor R. E. COOK, Head of the Department*

### TEACHING AND RESEARCH

*Professors: H. L. BUMGARDNER, W. E. DONALDSON, E. W. GLAZENER, P. B. HAMILTON, C. H. HILL; Professor Emeritus: C. W. BARBER; Associate Professors: W. L. BLOW, W. M. COLWELL, J. B. WARD; Adjunct Associate Professor: T. B. DAMERON JR.; Associate Professor Emeritus: F. W. COOK; Assistant Professors: D. M. BRIGGS, J. D. GARLICH, C. R. PARKHURST, W. R. PRINCE, D. G. SIMMONS, J. P. THAXTON*

### EXTENSION

*Professor W. C. MILLS JR., In Charge*

*Professors: W. G. ANDREWS, J. R. HARRIS; Professor Emeritus: C. F. PARRISH; Associate Professors: G. A. MARTIN, T. B. MORRIS; Assistant Professor: M. H. GEHLE; Assistant Professor Emeritus: C. J. MAUPIN; Instructor: J. R. WEST; Extension Specialist: C. E. BREWER*

The Department of Poultry Science provides instruction in the principles of poultry husbandry and in such related fields as nutrition, physiology, genetics and pathology.

Through teaching, research and extension the department serves students, poultrymen and allied industries. The production of poultry has increased rapidly during the last two decades. Poultry products rank second in North Carolina as a source of agricultural income. North Carolina ranks fourth nationally in the production of poultry products; the climatic and economic conditions in the State provide a sound base for continued expansion of poultry enterprises.

### OPPORTUNITIES

The change from small farm operations to large commercial poultry enterprises has created more specialized positions than are being filled by available poultry graduates. Off-the-farm operations in activities such as processing and distribution offer new job opportunities. The allied industries providing such services as feed, equipment, financing and drugs need more employees who have been trained in poultry science. Graduates hold positions as managers and field representatives for numerous businesses identified with or serving the poultry industry. Graduates are also employed in the areas of communication and public relations and as teachers and extension and research specialists. A number of graduates have established their own successful poultry business.

### UNDERGRADUATE CURRICULUM

Students desiring the Bachelor of Science degree with a major in poultry science may choose any of the three curricula offered by the School of Agriculture and Life Sciences. One may obtain a double major in certain other curricula through careful use of electives and/or summer school attendance. The student should consult the undergraduate advisers in the departments concerned.

For the freshman year and basic requirements see pages 65-70.

# POULTRY SCIENCE CURRICULUM

## BUSINESS PROGRAM

The curriculum may be selected by students desiring a background related to the operation and management of business firms on a sound economic basis. The general requirements for the business program are listed on pages 66-67. In addition, there are 26 hours of departmental requirements. These requirements include the poultry courses listed in the science curriculum below. PO 524 (ZO 524), Comparative Endocrinology, is not required. Additions are PO 301, Evaluation of Live Poultry, and PO 402, Commercial Poultry Enterprises. CH 103, General Chemistry II, may be substituted for CH 107, Principles of Chemistry. Should this substitution be made, the student is required to take CH 220, Introductory Organic Chemistry, instead of CH 221, Organic Chemistry I.

## TYPICAL CURRICULUM IN POULTRY SCIENCE

### SCIENCE PROGRAM

This curriculum is designed for the student who has an interest in the basic biological and physical sciences as greater emphasis is placed thereon. The student is better prepared for advanced study in various disciplines such as genetics, nutrition, physiology, and pathology. Several preveterinary students are currently enrolled in the curriculum.

For the freshman year, see pages 65-66.

#### SOPHOMORE YEAR

	<i>Credits</i>
CH 101 General Chemistry I .....	4
CH 107 Principles of Chemistry .....	4
English Elective .....	3
PO 201 Poultry Science and Production ..	4
PY 221 College Physics .....	5
or	
PY 211, PY 212 General Physics .....	8
Social Science and Humanities Electives ..	9
Physical Education .....	2

31 or 34

#### JUNIOR YEAR

	<i>Credits</i>
CH 221 Organic Chemistry I .....	4
GN 411 The Principles of Genetics .....	3
MB 401 General Microbiology .....	4
PO 405 Avian Physiology .....	4
Group A Elective .....	4
Group B or C Elective .....	3
Social Science and Humanities Elective ...	6
Free Electives .....	6

34

#### SENIOR YEAR

	<i>Credits</i>
PO 401 Poultry Diseases .....	4
PO 404 (FS 404) Poultry Products .....	3
PO 415 (ANS 415, NTR 415) Comparative	
Nutrition .....	3
PO 490 Poultry Seminar .....	1
PO 520 (GN 520) Poultry Breeding .....	3
PO 524 (ZO 524) Comparative	
Endocrinology .....	4
Group A Elective (If PY 212 is not taken) ..	4 or 8
Group B or C Elective .....	3
Free Electives .....	6

31 or 35

Total Hours for Graduation .....130

### TECHNOLOGY PROGRAM

The student desiring a more generalized program of study should select this curriculum which offers a greater selection of courses in the applied science and technology areas. The requirements for the sophomore and junior years are the

same as for the science curriculum as modified by the changes noted in Group A and departmental requirements for the business curriculum. The Group D courses required are indicated on page 70.

SENIOR YEAR

	<i>Credits</i>
PO 401 Poultry Diseases .....	4
PO 404 (FS 404) Poultry Products .....	3
PO 415 (ANS 415, NTR 415) Comparative Nutrition .....	3
PO 490 Poultry Seminar .....	1
PO 520 (GN 520) Poultry Breeding .....	3
Group A Elective .....	4
Group A, B or C Electives .....	7 or 11
Free Electives .....	6
	<hr/>
	31 or 35
Total Hours for Graduation .....	130

GRADUATE STUDY

The Department of Poultry Science offers the Master of Science degree in poultry science; doctoral programs in physiology, genetics, microbiology, and nutrition; and a professional master's program. Prospective applicants should consult the Graduate School Catalog.

PREMEDICAL SCIENCES

Gardner Hall

Premedical, predental and preveterinary curricula are offered in the School of Agriculture and Life Sciences. Requirements for all the premedical sciences are similar. Requirements may be met either through the science curriculum or the biological sciences curriculum. A number of students are accepted each year in leading medical colleges; several have received outstanding scholarships.

For further details on the preveterinary curriculum, see the following section.

For the premedical and predental details, see zoology, pages 110-114, and the biological sciences curriculum, pages 78-81.

PREVETERINARY

Grinnells Animal Health Laboratory  
Scott and Patterson Halls

- E. G. BATTE, *Adviser, Animal Science*
- G. B. CREED, *Adviser, Animal Science*
- J. R. HARRIS, *Adviser, Poultry Science*
- D. J. MONCOL, *Adviser, Animal Science*
- W. M. COLWELL, *Adviser, Poultry Science*
- D. G. SIMMONS, *Adviser, Poultry Science*
- E. W. GLAZENER, *Secretary, N. C. Veterinary Certification Committee*

A preveterinary curriculum is offered as part of the North Carolina Veterinary Program. After the completion of the prescribed program North Carolina students are nominated to attend the University of Georgia, Oklahoma State University, Tuskegee Institute and other colleges of veterinary medicine in which the State has made arrangements through the Southern Regional Education Board for these students to attend at in-state tuition rates.

If three years are completed in the preveterinary curriculum, some course credits may be transferred from the veterinary program to North Carolina State



EXTENSION

Associate Professor J. N. COLLINS, *In Charge of Community Development*

Professor: J. D. GEORGE; Professor Emeritus: J. W. CRAWFORD; Associate Professor: T. N. HOBGOOD JR., M. E. VOLAND; Assistant Professors: J. A. CHRISTENSON, V. E. HAMILTON, C. E. LEWIS, J. M. STEWART, P. P. THOMPSON

The major aim of this department is to teach students the principles and techniques for understanding human group behavior. More specifically the department seeks: (1) to train students to become leaders in organizing groups and communities and in administering their programs; (2) to qualify exceptional students on the undergraduate and graduate levels for sociological research, teaching and extension work; (3) to solve problems in human group relations through scientific research; and (4) to extend research results to the people of the State.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in sociology is offered under the science curriculum of the School of Agriculture and Life Sciences.

CURRICULUM IN RURAL SOCIOLOGY

SCIENCE PROGRAM

For the freshman year and basic requirements see pages 65-70.

Group A Courses (26 Credits)		Departmental Requirements and Electives (26 Credits)	
	Credits		
GN 411 The Principles of Genetics or		ANT 252 Cultural Anthropology	3
GN 301 Genetics in Human Affairs	3	SOC 202 Principles of Sociology	3
GY 120 Physical Geology	3	SOC 301 Human Behavior	3
ST 311 Introduction to Statistics	3	SOC 341 Rural Society—U.S.A	3
Electives*	17	SOC 342 Rural Societies Around the World	3
		SOC 411 Community Relationships	3
		SOC 416 Research Methods	3
		Electives	8
		Total Hours for Graduation	130

\* Six credits may be elected from Groups B and C; additional electives, from Group D.

GRADUATE STUDY

The Master of Science, Master of Sociology and Doctor of Philosophy degrees are offered by this department. Prospective applicants should consult the Graduate School Catalog.

SOIL SCIENCE

Williams Hall

Professor C. B. MCCANTS, *Head of the Department*

TEACHING AND RESEARCH

Professors: W. V. BARTHOLOMEW, S. W. BUOL, M. G. COOK, R. B. DANIELS (USDA), C. B. DAVEY, J. W. FITTS (AID), W. A. JACKSON, E. J. KAMPRATH,

J. F. LUTZ, R. J. MCCrackEN, R. J. VOLK, J. B. WEBER, S. B. WEED, W. G. WOLTZ, W. W. WOODHOUSE JR.; *Adjunct Professors*: L. J. METZ, J. M. SPAIN; *Associate Professors*: F. R. COX, G. A. CUMMINGS, J. W. GILLIAM, J. D. HESKETH (USDA); R. E. MCCOLLUM, A. G. WOLLUM II; *Associate Professors Emeriti*: W. D. LEE, A. MEHLICH, W. H. RANKIN; *Research Associate Professor Emeritus*: J. R. PILAND; *Assistant Professors*: E. E. GAMBLE (USDA), C. K. MARTIN, C. D. RAPER JR., P. A. SANCHEZ, E. D. SENECA, J. E. SHELTON, R. W. SKAGGS, C. D. SOPHER; *Adjunct Assistant Professor*: D. W. EADDY; *Research Associate*: L. E. AULL, B. L. CARLILE, M. E. WATSON

## EXTENSION

*Professor G. L. JONES, In Charge of Agronomy Extension*

*Professor J. V. BAIRD; Associate Professor: J. A. PHILLIPS, Assistant Professor: D. L. TERRY; Instructor: J. S. BARNES*

The primary objectives of the Department of Soil Science are to train students in fundamentals of soils, develop in them an understanding and appreciation of soils as a resource, and present principles of soil management and utilization for both farm and nonagricultural purposes. Soils constitute one of the largest capital investments in farming and proper soil management is essential for efficient production. World food needs of the future will require people trained and conversant in soil resources and use of fertilizers. Nature and properties of the soils are important considerations in urban-suburban planning and development. Also, knowledge of soil and its interactions with potential pollutants are useful in conserving environmental quality. Therefore, the demand by educational, research, service, planning-development, conservation-related, and service agencies and agri-businesses for people trained in soils should continue to be great.

## OPPORTUNITIES

Soil science graduates are trained to fill positions of leadership and service in many areas of agricultural, conservation and resource planning work. Among these are opportunities as farm operators and managers; county agricultural extension agents and employees of other public advisory agencies; Soil Conservation Service and other conservation-related agency representatives; employees of planning and health-related agencies concerned with soil resources; and as technical representatives and salesmen in fertilizer companies and other agri-businesses. Provision is made for those students wishing a more thorough training in biological sciences, chemistry, mathematics and physics leading to graduate study. Students with advanced degrees have wide opportunities in teaching, research, service and extension with state, federal and private educational and research institutions and agencies. Also, there are increasing opportunities in support of agribusiness.

## UNDERGRADUATE CURRICULUM

The Bachelor of Science degree may be obtained in the Department of Soil Science under any of four curricula—business, science, technology or conservation. For the basic requirements and freshman year, see pages 65-70. The conservation curriculum is shown on pages 82-84.

## CURRICULA IN SOIL SCIENCE

### BUSINESS PROGRAM

This curriculum is designed for students desiring a background in business with a technical knowledge of soil science. The program requires the completion of

courses in the technology curriculum and the business courses as outlined on pages 66-67.

SCIENCE PROGRAM

<i>Physical and Biological Sciences</i>		<i>Credits</i>	<i>Departmental Requirements and Electives</i>		
BO 200	Plant Life	4	SSC 200	Soils	4
<i>Group A Courses</i>			SSC 341	Soil Fertility and Fertilizers	3
BO 421	Plant Physiology	4	SSC 452	Soil Classification	3
Chemistry	Electives	8	SSC 461	Soil and Water Conservation	3
MA 112, MA 212	Analytic Geometry and		SSC 462	Soil Management Systems	3
Calculus A, B		7	SSC 492	Senior Seminar in Soil Science	1
Group A	Elective	4	Departmental	Electives	9
			Total Hours for Graduation	130	

TYPICAL SOIL SCIENCE CURRICULUM

<i>SOPHOMORE YEAR</i>		<i>Credits</i>	<i>JUNIOR YEAR</i>		<i>Credits</i>
BO 200	Plant Life	4	CH 221	Organic Chemistry I	4
CH 101	General Chemistry I	4	Chemistry	Elective	4
CH 107	Principles of Chemistry	4	English	Elective	3
MA 112, MA 212	Analytic Geometry and		PY 211, 212	General Physics	8
Calculus A, B		7	SSC 341	Soil Fertility and Fertilizers	3
SP 231	Expository Speaking	3	SSC 452	Soil Classification	3
SSC 200	Soils	4	Social Science—Humanities	Electives	6
Social Science—Humanities	Elective	3	Free Electives		3
Physical Education		2			34
		31			
<i>SENIOR YEAR</i>		<i>Credits</i>			
BO 421	Plant Physiology	4			
SSC 461	Soil and Water Conservation	3			
SSC 462	Soil Management Systems	3			
SSC 492	Senior Seminar in Soil Science	1			
Departmental	Electives	8			
Group A	Elective	3			
Social Science and Humanities	Electives	6			
Free Electives		6			
		34			
Total Hours for Graduation		130			

TYPICAL AGRONOMY CURRICULUM\*

<i>SOPHOMORE YEAR</i>		<i>Credits</i>	<i>JUNIOR YEAR</i>		<i>Credits</i>
CH 101, CH 103	General Chemistry I, II	8	BO 421	Plant Physiology	4
CS 211	Crop Science	4	CH 220	Introductory Organic Chemistry	4
CS 214	Crop Science Laboratory	1	CS 312	Pastures and Forage Crops	3
Social Science—Humanities	Electives	6	PP 315	Plant Diseases	3
SP 231	Expository Speaking	3	PY 221	College Physics	5
SSC 200	Soils	4	SSC 341	Soil Fertility and Fertilizers	3
Group A, B, or C	Elective	3	SSC 452	Soil Classification	3
Physical Education		2	Social Science—Humanities	Electives	6
Literature	Elective	3	Free Elective		3
		34			34

## SENIOR YEAR

### Credits

CS 411 Environmental Aspects of Crop Production .....	2
CS 413 Plant Breeding .....	2
CS 414 Weed Science .....	3
GN 411 The Principles of Genetics .....	3
Social Science—Humanities Elective .....	3
SSC 461 Soil and Water Conservation .....	3
SSC 492 Senior Seminar in Soil Science ..	1
Group A, B, or C Elective .....	2-3
Free Electives .....	9
Departmental Electives .....	3

31-32

\* The Agronomy major is administered by the Departments of Crop Science and Soil Science and is listed under both departments. See crop science, pages 86-87, for curriculum requirements in agronomy.

## GRADUATE STUDY

The Department of Soil Science offers a professional master's program and programs leading to the degrees of Master of Science and Doctor of Philosophy. Prospective students should consult the Graduate School Catalog.

## ZOOLOGY

Gardner Hall

*Professor D. E. DAVIS, Head of the Department*

*Professors:* F. S. BARKALOW JR., R. HARKEMA, W. W. HASSLER, J. E. HOBIE, C. F. LYTLE, B. S. MARTOF, G. C. MILLER, T. L. QUAY, D. E. SMITH; *Adjunct Professors:* J. A. BUCKWALTER, D. H. K. LEE, R. T. RICE, P. N. WITT; *Professor Emeritus:* B. B. BRANDT; *Associate Professors:* P. C. BRADBURY, B. J. COPELAND, M. T. HUISE (USDI), J. F. ROBERTS; *Adjunct Associate Professors:* J. G. VANDENBERGH, R. B. WILLIAMS, D. A. WOLFE; *Assistant Professors:* G. T. BARTHALMUS, K. E. MUSE, G. B. PARDUE (USDI), G. G. SHAW, J. M. WHITSETT II, T. G. WOLCOTT; *Adjunct Assistant Professors:* F. A. CROSS, G. R. HUNTSMAN, T. A. LINTON; *Instructor:* N. A. MERCANDO; *Associate Members of the Faculty:* D. S. GROSCH, L. E. METTLER (Genetics); D. W. HAYNE (Statistics)

The Department of Zoology provides undergraduate and graduate instruction in many specialized areas of the biological sciences. Undergraduates study all levels of biological organization from the molecular to the community. Students majoring in the department are adequately prepared for graduate work in zoology and related fields of sciences. Participation in supervised programs of research is strongly encouraged. Basic training is also available for students planning to enter dentistry, medicine and veterinary medicine and allied health sciences, such as medical technology. Ecology is emphasized, including wildlife, fisheries, conservation, parasitology and marine science.

## OPPORTUNITIES

Students may choose to continue their study with graduate research work leading to the Master of Science and Doctor of Philosophy degrees in zoology and wildlife. However, numerous employment opportunities are available for Bachelor of Science graduates. Majors are qualified for positions in the medical sciences, various government agencies and private industries.

## UNDERGRADUATE CURRICULA

The Bachelor of Science degree with a major in zoology, wildlife biology or medical technology is offered under the science curriculum of the School of Agriculture and Life Sciences. Students selecting premedical, predental or preveterinary option may receive a degree in zoology.

The requirements for admission to medical, dental and veterinary schools vary slightly from those given below in the zoology curriculum. For specific requirements consult the catalog of those schools where you plan to apply for admission. Students majoring in fisheries can meet the requirements of either the zoology curriculum or the wildlife biology curriculum. A nursing program is available in cooperation with Rex Hospital. The program for the freshman year is listed on pages 65-66. The other basic requirements are listed in the science curriculum on page 66.

The student may specialize in several areas depending upon his interest and ability. The zoology sequence prepares students for graduate school. The clinical year for the medical technology program is taken at one of three affiliated hospitals. Students are advised, especially in their junior and senior years, by faculty in their specialty.

## REQUIRED COURSES IN ALL CURRICULA IN ZOOLOGY

	<i>Credits</i>		
CH 221 Organic Chemistry I .....	4	ZO 360 (BO 360) Introduction to Ecology ..	4
CH 223 Organic Chemistry II .....	4	or	
or		ZO 361 Vertebrate Embryology .....	4
BCH 351 Elementary Biochemistry ....	3	ZO 414 (BO 414) Cell Biology .....	3
ZO 201 Animal Life .....	4	or	
ZO 223 Comparative Anatomy .....	4	ZO 421 Vertebrate Physiology .....	3
or		ZO 415 Cellular & Animal Physiology	
ZO 351 Vertebrate Zoology .....	4	Laboratory .....	2

## TYPICAL CURRICULUM IN ZOOLOGY

### SCIENCE PROGRAM

For the freshman year see pages 65-66.

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I .....	4	BCH 351 Elementary Biochemistry ....	3
Language Elective .....	3	or	
Social Science and Humanities Electives ..	3	CH 223 Organic Chemistry II .....	4
Group A Elective .....	3	Language Elective .....	3
ZO 201 Animal Life .....	4	Social Science and Humanities Elective ...	3
Physical Education .....	1	ZO 223 Comparative Anatomy .....	4
	18	or	
		ZO 351 Vertebrate Zoology .....	4
		Physical Education .....	1
			14 or 15

### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ZO 360 (BO 360) Introduction to Ecology .	4	PY 212 General Physics .....	4
PY 211 General Physics .....	4	Social Science and Humanities Elective ...	3
Social Science and Humanities Elective ...	3	ZO 361 Vertebrate Embryology .....	4
Advised Elective .....	4	ZO 350 Invertebrate Zoology .....	4
	15	Elective .....	3
			18

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
GN 411 The Principles of Genetics .....	3	Group A Elective .....	3
GN 412 Elementary Genetics Laboratory .	1	ZO 590 Special Studies .....	2
Social Science and Humanities Elective ...	3	Advised Electives .....	10
ZO 414 (BO 414) Cell Biology .....	3		15
or		Total Hours for Graduation .....	130
ZO 421 Vertebrate Physiology .....	3		
ZO 415 Cellular & Animal Physiology			
Laboratory .....	2		
Electives .....	6		
	18		

## TYPICAL CURRICULUM IN WILDLIFE BIOLOGY

### SCIENCE PROGRAM

For the freshman year see pages 65-66.

For the sophomore year see the typical curriculum in zoology, page 111.

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 200 Plant Life .....	4	Botany Elective .....	4
PY 221 College Physics .....	5	ENT 410 (BS 410) Biology of Insects ...	3
Social Science and Humanities Electives ..	3	Social Science and Humanities Electives ..	6
Group A Elective .....	3	ZO 351 Vertebrate Zoology .....	4
ZO 221 Conservation of Natural			
Resources .....	3		17
	18		

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ZO 360 (BO 360) Introduction to Ecology ..	4	GN 411 The Principles of Genetics .....	4
ZO 415 Cellular & Animal Physiology		ST 311 Introduction to Statistics .....	3
Laboratory .....	2	ZO 350 Invertebrate Zoology .....	4
ZO 420 Fishery Science .....	3	Electives .....	6
ZO 421 Vertebrate Physiology .....	3		17
ZO 553 Principles of Wildlife Science .....	3	Total Hours for Graduation .....	130
Electives .....	3		
	18		

## TYPICAL CURRICULUM IN MEDICAL TECHNOLOGY

### SCIENCE PROGRAM

Two programs are available in medical technology. The first is a four-year collegiate curriculum with a Bachelor of Science degree in zoology (see above) followed by a year of training in any hospital clinical laboratory approved by the American Medical Association. The second program is designed to be completed in four calendar years. The student takes the prescribed curriculum for three years at North Carolina State University and a fourth year (12 months) of clinical training at an affiliated hospital. Successful completion of this program qualifies the student for a Bachelor of Science degree in medical technology from North Carolina State University. Acceptance by the clinical laboratory is competitive and students in either program outlined above must apply for clinical training. After completion of either program the student is eligible to take the national examination of the Board of Registry of Medical Technologists.

For the freshman year see pages 65-66.

## SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 315 Quantitative Analysis .....	4	Language or English Elective .....	3
Language or English Elective .....	3	MB 401 General Microbiology .....	4
Social Science and Humanities Elective ..	3	PY 221 College Physics .....	5
ZO 201 Animal Life .....	4	Social Science and Humanities Elective ..	3
Elective .....	3	Physical Education .....	1
Physical Education .....	1		
	<hr/> 18		<hr/> 16

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I .....	4	CH 223 Organic Chemistry II .....	4
Social Science and Humanities Elective ...	3	Social Science and Humanities Electives ..	6
Advised Elective .....	3	ZO 421 Vertebrate Physiology .....	3
ZO 223 Comparative Anatomy .....	4	or	
Elective .....	3	ZO 414 (BO 414) Cell Biology .....	3
	<hr/> 17	ZO 415 Cellular & Animal Physiology	
		Laboratory .....	2
		Elective .....	3
			<hr/> 18
		Credit Hours Through Junior Year ..	100

## SENIOR YEAR

A 12-month course in medical technology is to be taken at an affiliated hospital clinical laboratory.

	<i>Hours</i>
Microbiology .....	10.0
Bacteriology	
Mycobacteriology	
Mycology	
Parasitology	
Chemistry .....	8.5
Nuclear Medicine .....	1.5
Hematology .....	7.5
Urinalysis .....	2.5
Blood Bank .....	3.5
Serology .....	3.5
Histology .....	1.5
Coagulation .....	1.5
	<hr/>
Total .....	40.0

For curricula in conservation see pages 82-85.

## OPTIONS IN ZOOLOGY CURRICULUM

Students desiring to emphasize certain areas within zoology may choose an option:

## PREMEDICAL OR PREEDENTAL OPTION IN ZOOLOGY SCIENCE PROGRAM

<i>Departmental Requirements</i>	
General Physics .....	8
Comparative Anatomy .....	4
Organic Chemistry I, II .....	8
Quantitative Analysis .....	4
Genetics .....	4
Physiology .....	4-8
Embryology .....	4
Total Hours for Graduation .....	130

## FISHERIES OPTION IN ZOOLOGY

### SCIENCE PROGRAM

Physiology .....	5
Limnology .....	4
Ecology .....	4
Ichthyology .....	4
Fishery Science .....	3
Economic Insects .....	3
Advised Electives .....	4
Total Hours for Graduation .....	130

### GRADUATE STUDY

The Department of Zoology offers to qualified students the Master of Science and the Doctor of Philosophy degrees and a professional master's program. Prospective applicants should consult the Graduate School Catalog.

## AGRICULTURAL EXPERIMENT STATION

J. E. LEGATES, *Dean of Agriculture and Life Sciences*

J. C. WILLIAMSON JR., *Director of Research*

The Agricultural Experiment Station is the agricultural and forestry research agency of the State of North Carolina. It is funded principally by appropriations from the North Carolina General Assembly and an allocation of federal funds.

The purpose of the Agricultural Experiment Station is to conduct research bearing directly on or contributing to: (1) the development and maintenance of an effective agricultural and forestry industry in North Carolina, including economically sound sources of supplies and equipment needed in agriculture and forestry and market outlets for the products of agriculture and forestry, (2) the improvement of rural homes, rural life and rural environment, and (3) the maintenance of a reliable supply of agricultural and forestry products for the consuming public. This requires research to solve currently pressing problems and research to provide a foundation of scientific knowledge in the biological, physical and social sciences essential in solving problems.

The faculty of the research station conducts experiments in the greenhouse and laboratories of the University and throughout the State on 15 strategically located experimental farms and on farm land rented for short periods.

The Agricultural Experiment Station faculty brings to the University experts, whose teaching in many specialized fields of agriculture assures the maintenance of curricula of high standards. It contributes to the advanced training of students who are destined to become the leaders, teachers and investigators necessary in the maintenance of agriculture on sound and economic planes.

### PUBLICATIONS

The Agricultural Experiment Station publishes bulletins and scientific papers on research results conducted by the staff. Single copies of these publications are sent free upon request to anyone in the State.

### SERVICES

The staff diagnoses and interprets problems for farmers and agribusiness firms in North Carolina. It counsels farmers and others interested in the agricultural and forestry industry, presents radio programs devoted to the discussion of farm and forestry procedures, and writes letters on more specific problems of agriculture at the request of farmers, garden clubs members, and manufacturers of fertilizer,

fungicides and insecticides. It also takes part in several administrative functions of the University.

## AGRICULTURAL EXTENSION SERVICE

J. E. LEGATES, *Dean of the School of Agriculture and Life Sciences*

GEORGE HYATT JR., *Director of the Agricultural Extension Service*

The Agricultural Extension Service of North Carolina State University is a cooperative undertaking among the U. S. Department of Agriculture, the State of North Carolina and the 100 counties in the State. Its work is supported by federal funds made available under the Smith-Lever Act of 1914, as amended, and by state and county appropriations.

The federal and state appropriations are used to maintain an administrative and specialist staff and to pay a portion of the salary and the travel expenses of the county extension agents. Under this cooperative arrangement, the Agricultural Extension Service serves as the "educational arm" of the U. S. Department of Agriculture, and as the "field faculty" of North Carolina State University in the areas of agriculture, production and marketing, family living, 4-H and youth, community and natural resource development and environmental quality.

## OBJECTIVES

The primary purpose of the North Carolina Agricultural Extension Service is to take to the people of the State the latest and best information obtainable—particularly that which is related to agriculture and home economics—and help them to interpret and use this information in building a more prosperous and satisfying life.

To accomplish this purpose, the institution maintains a staff of trained specialists in each of the major subject matter areas. These specialists work primarily with and through the county agricultural and home economics agents in the conduct of a statewide educational program.

This program has sufficient flexibility to permit special attention to the problems, needs and interests of the people in each county. Educational assistance is given to individuals, families, industrial processing and marketing firms, other businesses and certain organizations. This includes work with adult men and women and boys and girls in both the city and the rural areas.

In carrying out this educational program, a variety of methods and techniques are employed: method and result demonstrations; meetings; visits to farms, homes and businesses; organized groups of men, women and youths; tours; leaflets, pamphlets and other printed materials, and mass media.

The basic sources of information to be taught through this educational program are the findings and recommendations resulting from research conducted by experiment stations in this and other states and by the U. S. Department of Agriculture.

## AGRICULTURAL INSTITUTE

Patterson Hall

J. E. LEGATES, *Dean of Agriculture and Life Sciences*

EDWARD W. GLAZENER, *Director of Academic Affairs*

H. B. CRAIG, *Assistant Director of Academic Affairs and Director of the Agricultural Institute*

A two-year program in agriculture was approved and money was appropriated for this purpose by the 1959 General Assembly.

This two-year program, named the North Carolina Agricultural Institute, operates at North Carolina State University.

The major objective of the Agricultural Institute is to provide technical training to the individual so that he may become more productive in an agricultural society. Specifically, instruction offered by the Agricultural Institute is designed to train men and women for those jobs in agriculture and related occupations that require technicians with education beyond the high school level. An individual with this type of training should have a better income, assume a more prominent role of leadership, and become an asset to agriculture and to his community.

The institutional programs of the Agricultural Institute are organized and conducted as a part of the over-all resident instruction program for the School of Agriculture and Life Sciences. The Institute is an addition to, and not a substitute for, the regular degree granting program of the School of Agriculture and Life Sciences. However, in order to provide students enrolled in the Institute with the best possible technical training, the faculty in residence for the four-year programs are responsible for organizing and teaching courses offered by the Institute.

People who have training similar to that which can be obtained in the courses offered in the Agricultural Institute are in demand by agricultural industries. As this demand changes, courses of study will be evaluated and alterations will be made to keep abreast of the times. Through such a system the programs provided by the Institute are aiding the technical manpower needs of agriculture in North Carolina.

## **OPPORTUNITIES**

Rapid technical advancement has been extremely important in changing agriculture from a small production industry to one of the largest industries in the nation. Today, the farmer uses scientifically developed seed, feed and fertilizer, does most of his work with machinery, and has scientific testing to support his management decisions. Increased production has allowed him to sell much of his production rather than just the surplus above home consumption. Farms have become larger due to these technological advances, and large amounts of capital are needed to operate successfully. All of these factors bring about dependence on outside sources of information and capital for success in a modern agricultural business.

Not only the person who farms, but the hundreds of related businesses that are a vital part of agriculture today, cannot operate successfully without men trained in technical skills.

## **ENTRANCE REQUIREMENTS**

Any individual who has received a diploma from an accredited high school or has passed the high school equivalency examination administered by the State Department of Public Instruction is eligible for entry into the Agricultural Institute. Each application will be reviewed and evaluated by the Institute Director before an applicant will be accepted.

## **PROGRAMS OF STUDY**

The ten programs of study currently offered are: agricultural equipment technology, field crops technology, flower and nursery crops technology, general agriculture, livestock management and technology (animal husbandry option and dairy husbandry option), pest control (agricultural pest control and urban and industrial pest control), soil technology and turfgrass management.

## **TYPE OF DEGREE AWARDED**

Graduates of the Agricultural Institute are awarded the Associate in Applied Agriculture degree.



*This plant pathology-forest resources course for undergraduates includes the study of forest tree diseases, including diagnosis, economic impact, and prevention and control of disease.*



*Students in the School of Design have similar courses the first two years in order to become more familiar with the whole scope of activity in design. Then they select the design profession in which they are most interested.*

# DESIGN

Brooks Hall

CLAUDE E. MCKINNEY, *Dean*

The School of Design in its brief history since 1948 has established a role as an experimental institution in broad fields of design. Although the school is experimentally oriented in its teaching and research, it nevertheless recognizes the dangers inherent in a materialist-technological civilization where there may be an over-reliance on the machine and the mechanical technology available for use in the design of man's physical environment. Therefore, attention is given to the larger responsibility of design, the art of humanizing the environment. Also, the school seeks to integrate the designer as a social human being and a scientist-designer and encourages and nurtures the comprehensive designer as the coordinator of the structural dynamics in the overall pattern of life.

While the school's first aim is to serve North Carolina and the regions of the South, the students are basically trained, through teaching, so that they will be capable of working in any region. Because character, a profound devotion, and an absolute professional commitment are prime ingredients of any creative activity where social responsibilities are vital, as in design, the school fosters and cultivates the integrity of the individual. The School of Design emphasizes individual creative expression and at the same time encourages and develops a capability and temperament for teamwork.

Faculty members have been selected for their individual and diverse personal philosophies and their individual, yet divergent, professional qualifications. The school has brought together creative personalities willing in their teaching to subordinate their own professional interests to the interests of their students. Each faculty member gives the student the benefit of his professional knowledge, technical training, and experience as a citizen.

To combat the dangers of over specialization, the school seeks to develop the personality and character of the student as a whole. The goal in the growth of the student is not only the mastery of design techniques in his profession; but through the stimulation and the development of the intellectual and emotional capacity together, a readiness is developed to meet the challenge of any environment.

The School of Design is intended to act as an educational center which unifies the different design professions in the fundamental knowledge and methods which they share; its further intention is the education of men who will be competent within the specific demands and limitations of a particular field of design. The existence of contemporary man and the greatest purpose of contemporary design is considered to be the solution of those requirements through full use of the ingenuity, knowledge, and understanding of contemporary man. Through this point of view, the technical and factual aspects of design present no conflict with its philosophical and aesthetic standards.

The School of Design presently offers undergraduate programs in architecture, landscape architecture and product design; and graduate programs in architecture, urban design, landscape architecture and product design.

In all of the professional fields where studies are now established in the school, the methods and values which are common to all designers are separated only by the study of the application of the work in a single profession. Many classes throughout the curricula will include students in these professional fields, and for all students the course of study is similar during the first two years in order that, having become more familiar with the whole scope of activity in design, they may then select the design profession in which they are most interested. From his first day in class to his last, the student is asked to design, and he is counseled so that he may become a responsible professional in the broadest sense.

## THE COMMON FIRST TWO YEARS

The common first two years or the basic design program, encompassing the first two years of the student's design education, has its foundation in the student's utilization of his previous development as he initiates his design education. When he is able to clearly define and express his interests, the course structure can be molded to accommodate him. As students begin the selection of their professional education, there is considerable variation in their directions. In order for the student of design to make a choice that would be in his best interest, he will first need exposure to situations in which he can learn to explicitly define the alternatives. Therefore, the basic design program offers the learner a range of experiences. These experiences are gained through active participation in the academic community as a whole, as well as through courses offered within the School of Design. A program that encourages students to discover various interfaces that occur between the actions of the participant and the environment for design is properly an interdisciplinary activity which utilizes the knowledge from a variety of related disciplines. He achieves, through physical form, an expression of the complex values and meanings of our society.

## CURRICULA AND DEGREES

The School of Design offers undergraduate instruction in architecture, landscape architecture and product design. The school also offers graduate studies in four distinct fields—architecture, urban design, landscape architecture and product design. The four-year undergraduate programs in architecture, landscape architecture and product design which offers an option in visual design lead to the Bachelor of Environmental Design degree. Graduate programs leading to the Master of Architecture, Master of Landscape Architecture and Master of Product Design degree normally require two years of residence although they may be extended for students who enter the fields from nondesign backgrounds. The Master of Urban Design program also requires two or more years and is open to students from nondesign backgrounds as well as design backgrounds. The five-year undergraduate program in product design which offers an option in visual design leading to the Bachelor of Product Design degree will be phased out at the end of the spring semester 1974.

## FACILITIES

The School of Design is located in Brooks Hall, the former college library. The main building, a large additional space in nearby Leazar Hall and a smaller space in Tompkins Hall provide 28,618 square feet of space for offices, classrooms, drafting rooms and studios, as well as laboratories for design research. The school has well-equipped and supervised shop facilities. The Harrye B. Lyons Design Library contains more than 14,068 volumes, 25,997 slides and subscriptions to 189 design periodicals. The drafting rooms and studios have been designed to accommodate small classes, thereby assuring a personal relationship between teacher and student in the development of the student's creative abilities. All facilities in the school have been planned to provide a scholarly environment for effective teaching and laboratory instruction.

## OPPORTUNITIES

State law now requires the graduate architect to work not less than three years in the offices of registered architects and then to pass a written examination given by the North Carolina Board of Architecture before he is ready to begin his own practice. Accelerating activity in building construction and urban redevelopment has brought about a significant increase in work in architectural offices in the South, offering attractive positions for the architecture graduate. The architecture graduate is also qualified for positions in certain branches of engineering, building research and teaching.

The accelerated urban growth of the 20th century has created an unprecedented demand for landscape architects that far exceeds the production of the schools. Positions exist in both public and private organizations, encompassing a range of interests from city and regional planning to residential developments. For the competent graduate, advancement is rapid and remuneration above the average.

The Department of Product Design, which was established in September, 1958, as the third department of the school, prepares its graduates to work as resident designers with such industries as furniture manufacturing and other essential and important industries of North Carolina and the region. Graduates of the department are also qualified to establish offices as professional industrial designers.

Evidence of the soundness of the course of study and the programs in design at North Carolina State University is reflected by three of the school's graduates who have been awarded fellowships to the American Academy in Rome—a prize awarded annually to design graduates in the United States and affording two years of advanced study in Europe, providing all expenses and residence at the American Academy in Rome. Five graduates of the school have won the top academic award in architecture, the Paris Prize, which is a scholarship worth \$5,000 for a year's study in Europe. Seventeen graduates of the school have won the coveted Fulbright Scholarship for foreign travel and study. The faculty, graduates and students of the school have won more than \$375,000 in prizes and scholarships since the establishment of the school in 1948.

## ARCHITECTURE

Brooks Hall

*Professor* ROBERT P. BURNS JR., *Head of the Department*

*Professors:* J. H. COX, H. H. HARRIS, D. R. STUART; *Professor Emeritus:* H. L. KAMPHOEFFNER; *Associate Professors:* P. BATCHELOR, G. L. BIRELINE JR., R. H. CLARK, R. W. MUSSELWHITE, G. J. P. REUER, H. SANOFF, V. SHOGREN; *Assistant Professors:* A. J. AHO, D. W. BARNES JR., E. P. BRANTLY, E. W. TAYLOR; *Instructor:* LYNNE M. GAY; *Librarian:* HELEN K. ZSCHAU

Architecture finds itself, upon entering the final three decades of the 20th century, at a critical stage in its historical development. The architect's traditional problem of giving meaningful form to man's physical environment remains his chief concern, but this task has been vastly complicated by the forces of accelerating world urbanization and the technological revolution which is rapidly altering every facet of contemporary life. Social upheaval in the cities, ruthless violation of our landscape and natural resources, congestion and decay of our urban centers, obsolescence and inefficiency at every level of our transportation systems, the tendency toward giantism and anonymity in all of man's institutions—these are but a few elements in the complex condition of modern society with which the architect is confronted. The pastoral, the picturesque, the arrogantly lavish and the purely aesthetic have little relevance for a society whose design needs are so demanding that only the most broadly educated, intelligent, and creative professionals can hope to cope with them. It is this type of professional that the Department of Architecture attempts to prepare—individuals with a profound understanding of man and his cultural context, with a deep commitment to the ordering of the physical environment, and with the necessary tools for accomplishing these objectives.

Inherent in the architectural program is recognition of the evolving role of the architect. While individual creativity and decision-making abilities are no less important, it is clear that the architect increasingly functions as member and frequently as coordinator of a team of professionals—engineers, planners, political and behavioral scientists, economists and others—who together are able to formulate the comprehensive programs adequate to meet today's most urgent environmental problems.

It becomes obvious that no monolithic academic program can serve the requirements of architecture students with highly divergent interests and capabilities,

nor indeed the varied needs of the present-day architecture profession. The curriculum in architecture, while providing a broad basic structure common to all students, encourages individual diversity through a major elective program of in-depth study in one of several design-related fields leading to expanded background in social and cultural factors, programming and analytic methods, technological issues, urban affairs, visual studies, management and operations, economics or natural systems. Through interdisciplinary studies in the school and University and through the use of outside consultants, the interdependence of the architect with related professionals is strongly emphasized. The design studio is transformed into a working laboratory in which analysis and synthesis become real and meaningful activities to the students.

Considering the changing requirements in the field of architecture, and the increasing complexity of tasks facing today's architect, a six-year, two-degree curriculum has been established, replacing the previous five-year Bachelor of Architecture program. The major characteristic of the new curriculum is the formal organization of studies into logical two-year cycles.

The freshman and sophomore years combining general studies and introductory design exercises constitute the "Basic Design Program" common to all architecture, landscape architecture and product design students in the School of Design.

The junior and senior years mark the formal introduction to architectural studies and form the "Preprofessional Program". This first four-year program requires 129 semester hours and leads to the nonprofessional degree of Bachelor of Environmental Design. The third cycle is designated as the "Professional Program" in which the student undertakes two years of graduate study leading to the professional degree of Master of Architecture.

For students not advancing to the final cycle of graduate studies, the four-year undergraduate curriculum is designed as a terminal program qualifying graduates to enter architecture at an intermediate level or related fields outside of architecture.

In terms of its larger responsibilities in the total preparation of the architect, the Department of Architecture acknowledges a divided but overlapping obligation with the profession. While office experience should extend the young architect's knowledge of technical aspects as well as judgmental maturity during the period of apprenticeship, it is the particular task of the department and the University to develop fundamental abilities in conceptual and developmental design and to provide a philosophical and theoretical basis for creative life as an architect and as an individual.

## ARCHITECTURE CURRICULUM

### FIRST YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 101 Environmental Design I .....	3	DN 102 Environmental Design II .....	3
DN 111 Perception and Communication I ..	3	DN 112 Perception and Communication II ..	3
DN 121 History of Design I .....	3	DN 122 History of Design II .....	3
ENG 111 Composition and Rhetoric .....	3	ENG 112 Composition and Reading .....	3
Mathematics* .....	3 or 4	Mathematics* .....	3 or 4
Physical Education .....	1	Physical Education .....	1
<hr/>		<hr/>	
16 or 17		16 or 17	

### SECOND YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 201 Environmental Design III .....	4	DN 202 Environmental Design IV .....	4
DN 211 Visual Communication I .....	2	DN 212 Visual Communication II .....	2
Required Science Elective** .....	4	Required Science Elective** .....	4
Electives***** .....	6	Electives***** .....	6
Physical Education .....	1	Physical Education .....	1
<hr/>		<hr/>	
17		17	

### THIRD AND FOURTH YEARS

	<i>Credits</i>
ARC 400 Intermediate Architectural Design (Series)***	16
Structures	12
Professional Options****	10
Electives*****	24
	62

Total Hours for the Bachelor of Environmental Design in Architecture—129

\*Excluding credit for MA 111, must include one calculus course.

\*\*Selected from natural, physical or biological sciences, but not to include math or computer science.

\*\*\*Four semesters at four credit hours per semester required in Intermediate Architectural Design or equivalent.

\*\*\*\*To be selected from professional options offered in the School of Design or other equivalent courses offered in the University. Must include ARC 331 and ARC 332.

\*\*\*\*\*Thirty-six credit hours of electives which will be divided into three equal groups of 12 hours each:

- a. Social science—humanities group.
- b. Advised group—selected by student with adviser's approval to develop an area of concentration outside his major.
- c. Unrestricted group.

## LANDSCAPE ARCHITECTURE

Brooks Hall

*Professor R. R. WILKINSON, Head of the Department*

*Professors: J. H. COX, D. R. STUART, E. G. THURLOW; Associate Professors: G. L. BIRELINE JR., D. H. ENSIGN, R. W. MUSSELWHITE; Assistant Professors: R. T. HESTER JR., J. PORTER, J. RANDLE*

Landscape architecture is the design profession charged with the stewardship of the landscape. A primary responsibility within that charge is the development and application of the skill to arrange man-made features on the landscape for their use by society. Environmental quality is the standard of achievement in the profession. There are approximately 7,500 professional landscape architects practicing in the United States. Their activities range from site planning for urban complexes, community design, park and open space design, campus planning to the development of regional networks of transportation, recreation and cities. The federal government is the largest employer of landscape architects. Other landscape architects are owners and associates in private consulting firms for designing facilities for the entire range of community and institutional building programs.

The Department of Landscape Architecture at North Carolina State University is committed to preparing students for careers in environmental and landscape design. The design disciplines, however, are not producers of all the knowledge necessary to support their activities; they are consumers. The educational function of design schools is to develop in young people the basic understanding of the natural and social world. Formal insights gained from the sciences and arts are applied to a wide range of environmental problems through the professional courses.

The emphasis in the professional course work is basic problem-solving, technical competence and innovation. The latter is an extension of the aesthetic appreciation that has been the traditional role of design. The faculty is aware of the state of decay, misuse and poor judgment that has become our environmental legacy. It is a matter of urgency that young people be capable of understanding the process of physical development and be committed to its application for the benefit of future as well as present users.

The challenge facing young designers is enormous and the reward can be a personally satisfying, creative and essential career.

## LANDSCAPE ARCHITECTURE CURRICULUM

### FIRST YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 101 Environmental Design I .....	3	DN 102 Environmental Design II .....	3
DN 111 Perception and Communication I ..	3	DN 112 Perception and Communication II .	3
DN 121 History of Design I .....	3	DN 122 History of Design II .....	3
ENG 111 Composition and Rhetoric .....	3	ENG 112 Composition and Rhetoric .....	3
Mathematics* .....	3 or 4	Mathematics* .....	3 or 4
Physical Education .....	1	Physical Education .....	1
	<hr/> 16 or 17		<hr/> 16 or 17

### SECOND YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 201 Environmental Design III .....	4	DN 202 Environmental Design IV .....	4
DN 211 Visual Communication I .....	2	DN 212 Visual Communication II .....	2
Required Science Elective** .....	4	Required Science Electives** .....	4
Electives*** .....	6	Electives*** .....	6
Physical Education .....	1	Physical Education .....	1
	<hr/> 17		<hr/> 17

### THIRD AND FOURTH YEARS

	<i>Credits</i>
LAR 400 Intermediate Landscape Architectural Design (Series)****	16
DN 422 History of Design III	3
Landscape Technology*****	9
Professional Options*****	10
Electives***	24
	<hr/> 62

Total Hours for the Bachelor of Environmental Design in Landscape Architecture—129

\*Excluding credit for MA 111, must include one calculus course.

\*\*Selected from natural, physical or biological sciences but not to include math or computer science.

\*\*\*Thirty-six credit hours of electives which will be divided into three groups, 12 hours each:

a. Social science and humanities group.

b. Advised group of electives selected by student with adviser's approval to develop an area of concentration outside his major.

c. Unrestricted group.

\*\*\*\*LAR 400 Series: four semesters of 4 credit hours each. Required in landscape architectural design or equivalent.

\*\*\*\*\*Landscape Technology Series to be elected from departmental offerings or equivalent courses within the University.

\*\*\*\*\*Professional options to be selected from professional options in the School of Design or other equivalent courses within the University and to include ARC 441, Design Methods.

## PRODUCT DESIGN

Brooks Hall

*Associate Professor V. M. FOOTE, Acting Head of the Department*

*Professors: J. H. COX, D. R. STUART; Associate Professors: G. L. BIRELINE JR., F. EICHENBERGER, H. A. MACKIE, D. A. MASTERTON, R. W. MUSSELWHITE; Assistant Professors: A. V. COOKE, G. HEDGE; Instructor: M. D. DOTY*

Product Design, or industrial design, has in the last 35 years grown into a profession of eminent significance in the cultural and economic life of this country. While originally concerned solely with helping industry create mass-produced consumer products of good appearance, the profession has during the last two decades begun to play an increasingly important role as a synthesizing force in product planning, product research and total product development.

Concurrently, education of the product designer has shifted from the education of a stylist, concerned only with product appearance, to the education of a designer concerned with such varying disciplines as psychology, engineering, manufacturing and marketing.

Since the department was founded more than a decade ago, the department has been engaged in training competent product designers able to operate effectively in any field of industry where innovation in problem solving is required. During the undergraduate program, the Department of Product Design attempts to inculcate in the student a generalized rather than a specialized approach to the solution of design problems. The student is taught to treat man and his environment in terms of whole systems rather than isolated or component parts. Emphasis is placed on general overall solutions to human problems from which specific objects are extrapolated.

The growing affluence of our society has created an expanding need for new products. This coupled with an ever increasing middle class and shorter working hours has substantially broadened the industrial requirements for competent designers—designers who are able to handle the increasing complexities of materials and manufacturing developments, as well as satisfying the physical and psychological needs of the consumer.

In order to achieve these ends, it has become necessary for the designer to involve himself in three major design and research activities:

- a. man's behavior
- b. the man-machine relationship
- c. the machine itself.

Only the most broadly educated and talented designers are able to fulfill the needs of this new industrialized society—graduates who will aid in the solution of the numerous human problems that surround us on a regional, national and international scale.

## **VISUAL DESIGN OPTION**

The modern world has come to the realization that science—until recently—has not felt it necessary for man to play a central role in the history of natural events. In the 20th century we have found that the new science of communication media has created a demand for people with operational knowledge of the various forms of visual communication. One set of these demands has to do with people able to carry out activities which have come to be known as visual design.

The history of visual design is one of separate skills and crafts which have now merged into a cohesive field of study. Such activities are:

- a. Book, pamphlet, and brochure design (publishing, typography, printing, etc.).
- b. Package design.
- c. Signing and symbol creation (indesimal and iconic indications).
- d. Advertising design (newspapers, magazines, cinema, television).
- e. Educational and commercial exhibition and display design.
- f. Human factors information display design.
- g. Development of techniques for analyzing visual character and its relation to social and behavioral functions in the urban environment.
- h. Problem-solving approaches; exploration of visual means for solving socially defined problems.

Working through a broad range of visually creative experience, the student will develop an understanding of elements and principles of visual organization common to all visual communication. Upon receiving his undergraduate degree the student would be prepared to enter the professional field or be in a position to enter graduate schools for continued study in specific areas.

The undergraduate curriculum in product design or the visual design option is a four year program leading to the Bachelor of Environmental Design degree. One hundred twenty-nine hours are required for graduation. The present five year program leading to the Bachelor of Product Design or Bachelor of Product Design with a Visual Design option will be phased out at the end of the spring semester 1974.

## PRODUCT DESIGN CURRICULUM

### FIRST YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 101 Environmental Design I .....	3	DN 102 Environmental Design II .....	3
DN 111 Perception and Communication I ..	3	DN 112 Perception and Communication II ..	3
DN 121 History of Design I .....	3	DN 122 History of Design II .....	3
ENG 111 Composition and Rhetoric .....	3	ENG 112 Composition and Reading .....	3
Mathematics* .....	3 or 4	Mathematics* .....	3 or 4
Physical Education .....	1	Physical Education .....	1
<hr/>		<hr/>	
16 or 17			

### SECOND YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 201 Environmental Design III .....	4	DN 202 Environmental Design IV .....	4
DN 211 Visual Communication I .....	2	DN 212 Visual Communication II .....	2
Required Science Electives** .....	4	Required Science Electives** .....	4
Electives***** .....	6	Electives***** .....	6
Physical Education .....	1	Physical Education .....	1
<hr/>		<hr/>	
17		17	

### THIRD AND FOURTH YEARS

	<i>Credits</i>
PD 400 Intermediate Product Design (Series) or PD 440 Intermediate Visual Design (Series)*** .....	16
Product Design Technology**** .....	6
Professional Options***** .....	16
Electives***** .....	24
<hr/>	
Total Hours for the Bachelor of Environmental Design in Product Design or Visual Design Option—129	62

\*Excluding credit for MA 111, must include one calculus course.

\*\*Selected from natural, physical or biological sciences, but not to include mathematics or computer science.

\*\*\*Four semesters at four credit hours per semester required in Intermediate Product Design or equivalent.

\*\*\*\*Product Design Technology Series to be elected from departmental offerings or equivalent courses within the University.

\*\*\*\*\*To be selected from professional options offered in the School of Design or appropriate courses offered in the University. Must include four semesters of PD 490, Intermediate Special Projects Series, as well as PD 421, PD 422 and PD 431.

# FIFTH YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
PD 501 Advanced Product Design V		PD 502 Advanced Product Design VI	
or		or	
PD 541 Advanced Visual Design I . . . . .	7	PD 542 Advanced Visual Design II . . . . .	7
PD 590 Special Projects . . . . .	3	PD 591 Special Projects . . . . .	3
Electives***** . . . . .	3	Electives***** . . . . .	3
	13		13

Total Hours for the Bachelor of Product Design  
or Visual Design Option—153  
(To be phased out at the end of the spring  
semester 1974)

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- \*\*\*\*\*Thirty-six credit hours of electives which will be divided into three equal groups of 12 hours each:
- Social science/humanities group.
  - Advised group of electives selected by student with adviser's approval to develop an area of concentration outside his major.
  - Unrestricted group.



*Poe Hall houses the latest in educational facilities, including a materials curriculum center, science and industrial arts laboratories and child play and guidance observation rooms.*

# EDUCATION

Poe Hall

CARL J. DOLCE, *Dean*

*Adjunct Professor:* THELMA L. ROUNDTREE; *Associate Professors:* L. J. BETTS, S. D. IVIE, P. J. RUST, T. N. WALTERS; *Adjunct Associate Professor:* H. G. ROYALL JR.; *Assistant Professors:* C. W. HARPER JR., D. R. KNIEFEL, H. E. MUNN JR., BARBARA M. PARRAMORE, C. R. REYNOLDS; *Instructors:* W. L. COX JR., KATHLEEN A. MCCUTCHEN, R. E. REEVE, ALICE S. WECK; *Teaching Technician:* J. R. GIBSON

The School of Education is concerned with the problems of human development both in the setting of schools and in less traditional types of educational activities. With an emphasis upon the preparation of teachers, the school seeks students who are dedicated to the improvement of mankind through education and who are sensitive to the feelings, desires and aspirations of others.

The school is composed of the Division of Education, Departments of Adult and Community College Education, Agricultural Education, Industrial and Technical Education, Mathematics and Science Education, Guidance and Personnel Services and Psychology.

Undergraduate degree programs are offered in agricultural education, industrial arts education, vocational industrial education, technical education, mathematics education, science education and psychology.

Graduate degree programs are offered in adult and community college education, agricultural education, industrial arts education, vocational industrial education, technical education, mathematics education, science education, guidance and personnel services, psychology and occupational education.

Graduates of the undergraduate programs in education receive a Bachelor of Science degree in education and qualify for a Grade "A" Certificate to teach in their chosen fields. Graduates of the undergraduate program in psychology receive a Bachelor of Arts in psychology degree. Graduate programs confer the Master of Science or Master of Education degrees.

Professional education courses are provided for those students enrolled in the School of Liberal Arts who wish to become teachers of English, social studies, modern foreign languages and speech.

A modern, well-equipped School of Education building includes a curriculum materials center, industrial arts laboratories, science laboratories, as well as the latest developments in teaching technology, child play and guidance observation rooms.

## ADULT AND COMMUNITY COLLEGE EDUCATION

(Also see agriculture and life sciences.)

Ricks Hall

*Professor E. J. BOONE, Head of the Department*

## TEACHING, RESEARCH AND EXTENSION

*Professors:* M. BURT, C. TRENT; *Extension Professor:* J. D. GEORGE; *Adjunct Professor:* B. E. FOUNTAIN JR.; *Associate Professors:* W. L. CARPENTER, W. L. GRAGG; *Assistant Professors:* J. C. GLASS JR., D. B. LUMSDEN, K. B. SEGNER III, JERRY PARSONS, R. W. SHEARON; *Extension Assistant Professors:* D. M. JENKINS, ESTELLE E. WHITE; *Adjunct Assistant Professor:* C. J. LAW JR.; *Extension Instructor:* J. D. DODSON

The adult and community college education faculty offers instruction at advanced undergraduate and graduate levels. The advanced undergraduate courses are designed to support the other departments of the institution, giving students a background in adult and community college education. The graduate program is designed to increase the professional competence of adult and community college educators in developing and administering adult and community college education programs and in conducting scholarly research in the field.

## UNDERGRADUATE PROGRAM

The department does not have a program leading to a bachelor's degree.

## GRADUATE STUDY

The department offers the Master of Science, Master of Education or Doctor of Education degrees with a major in adult and community college education. Prospective applicants should consult the Graduate School Catalog.

## AGRICULTURAL EDUCATION

Poe Hall

*Professor C. C. SCARBOROUGH, Head of the Department*

*Professor: J. K. COSTER; Professor Emeritus: J. B. KIRKLAND; Associate Professor: T. R. MILLER; Adjunct Associate Professor: C. H. ROGERS; Assistant Professor: C. D. BRYANT; Adjunct Assistant Professor: W. J. BROWN JR.*

Agricultural education in its broadest sense, should encompass areas of study which will enable one to participate effectively in planning, promoting and initiating programs in education in agriculture. Therefore, the description of a graduate in agricultural education would be more nearly an "educational leader" than an "agricultural specialist."

## UNDERGRADUATE PROGRAM

The program in agricultural education includes education for personal development and educational leadership. These areas in the program are divided into three groups: (1) general education, (2) technical or special education, and (3) professional education.

General education includes the education which everyone should have, namely, preparation for living effectively (1) with one's self, (2) with one's family, (3) in a community, (4) as a local, state, national and world citizen, and (5) bringing to bear the knowledge of man in solving problems.

Special, or technical education, consists of securing an understanding and ability to solve agricultural problems, with emphasis upon managerial aspects. There is now a choice of specialty areas in agriculture, as well as qualifying as a "double major."

Professional education includes an understanding of human behavior and development. Particular attention is given to an understanding of the learning process—as it occurs and how it can be accelerated. Consideration is also given to understanding how people work together in groups, particularly in rural communities. Ability to do research in the community is essential.

The highlight of the curriculum for most students is the student teaching semester which provides full-time teaching and related experiences in education programs.

FACILITIES AND RESOURCES

In addition to the University facilities and resources, the administrative personnel of most of the state agricultural and educational agencies and programs have offices in Raleigh. These people often serve as valuable resource people to students in agricultural education.

AGRICULTURAL EDUCATION CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ALS 103 Orientation .....	1	ENG 112 Composition & Reading .....	3
BS 100 General Biology .....	4	Mathematics Elective .....	3-4
ED 102 Objectives in Agricultural Education .....	1	Animal Science Elective .....	4
ENG 111 Composition & Rhetoric .....	3	Plant Science Elective .....	3
History Elective .....	3	Physical Education .....	1
MA 111 Algebra & Trigonometry .....	4		
Physical Education .....	1		
	17		14-15

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EC 205 Economic Activity .....	3	EC 212 Economics of Agriculture .....	3
CH 111 Foundations of Chemistry .....	5	PY 221 College Physics .....	5
BAE 211 Farm Machinery .....	4	SSC 200 Soils .....	4
Agricultural Elective .....	3	PSY 200 Introduction to Psychology .....	3
Physical Education .....	1	Physical Education .....	1
	16		16

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 344 Secondary Education .....	3	ED 313 Contemporary Vocational Agriculture .....	3
PSY 304 Educational Psychology .....	3	Fine Arts Elective .....	3
Agricultural Elective .....	3	PS 201 American Governmental Systems ..	3
SOC 202 Principles of Sociology .....	3	SP 230 Fundamentals of Speech .....	3
Elective .....	3	Agricultural Elective .....	3
	15	Elective .....	3
			18

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 411 Student Teaching in Agriculture* .	8	Agricultural Elective .....	3
ED 412 Teaching Adults* .....	2	Literature Elective .....	3
ED 413 Planning Educational Programs* .	2	Philosophy or Religion Elective .....	3
ED 420 Principles of Guidance* .....	2	Elective .....	6
PSY 476 Psychology of Adolescence* .....	2		
SOC 416 Research Methods* .....	3		
	19		15
		Total Hours for Graduation—130	

\*These courses are taken as a block in the professional semester, either spring or fall semester.

## **GUIDANCE AND PERSONNEL SERVICES**

Poe Hall

*Professor W. E. HOPKE, Head of the Department*

*Professor: C. G. MOREHEAD; Professor Emeritus: R. N. ANDERSON; Associate Professor: B. C. TALLEY JR.; Assistant Professor: L. K. JONES; Instructor: JULIE G. MCVAY*

The department offers work leading to the Master of Science, Master of Education, sixth year and Doctor of Education degrees with a major in the field of guidance and personnel services (or counselor education). Each of these degrees is designed to prepare individuals for guidance and personnel positions at various levels in elementary and secondary schools, junior and community colleges, trade and technical schools and institutes, institutions of higher education agencies (such as employment and rehabilitation offices), as well as guidance and personnel work in business, industry and government. Prospective applicants should consult the Graduate School Catalog.

## **INDUSTRIAL AND TECHNICAL EDUCATION**

Poe Hall

*Professor D. M. HANSON, Head of the Department*

*Professors: J. T. NERDEN, D. W. OLSON; Professor Emeritus: I. HOSTETLER; Associate Professor: T. B. YOUNG; Assistant Professors: T. C. SHORE JR., F. S. SMITH, R. T. TROXLER; Adjunct Assistant Professor: W. A. MCINTOSH; Instructors: E. A. BAME, W. M. PARKER*

The Department of Industrial and Technical Education offers curricula to prepare teachers, supervisors and administrators for the public schools, area vocational schools, community colleges and technical institutes. Complete four-year curricula in industrial arts education, vocational industrial education and technical education leading to the Bachelor of Science in education degree are available in the department. The curricula are planned to provide students with broad cultural and professional backgrounds to parallel occupational experience.

## **OPPORTUNITIES**

Students completing the requirements of the industrial and technical education curricula will be prepared to teach industrial arts or trade and/or technical subjects. Students may also prepare for positions as industrial cooperative training coordinators in secondary schools.

## **GRADUATE STUDY**

The department offers the Master of Science, Master of Education or Doctor of Education degrees. Prospective applicants should consult the Graduate School Catalog.

## **VOCATIONAL INDUSTRIAL EDUCATION**

Poe Hall

The curriculum in vocational industrial education is designed to prepare vocational teachers for the secondary schools, area vocational schools and post-secondary school vocational programs. Upon satisfactory completion of the curriculum the graduate is qualified to teach in any of the aforementioned vocational areas.

# OPPORTUNITIES

Graduates of the vocational industrial education curriculum have a wide selection of employment opportunities. The rapid growth of the vocational programs in the secondary schools in all fields has created an urgent demand for vocational teachers, and the selection is attractive. A student may qualify for teaching positions in introduction to industrial education, trade preparatory training and industrial cooperative training in these fast-growing programs in the secondary schools.

Other opportunities include teaching in the area vocational schools, in industry and in the post-secondary schools.

## VOCATIONAL INDUSTRIAL EDUCATION CURRICULUM

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I .....	4	ENG 112 Composition and Reading .....	3
ED 100 Introduction to Industrial Education .....	2	History Elective .....	3
ENG 111 Composition and Rhetoric .....	3	IA 105 Drafting .....	4
MA 111 Algebra & Trigonometry .....	4	MA 112 Analytic Geometry & Calculus A ..	4
Physical Education .....	1	or	
		MA 112 Mathematics of Finance & Elementary Statistics .....	4
	14	Physical Education .....	1
			15

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
PS 201 The American Governmental System .....	3	EC 205 Economic Activity .....	3
PSY 200 Introduction to Psychology .....	3	PY 212 General Physics .....	4
PY 211 General Physics .....	4	SOC 202 Principles of Sociology .....	3
SP 230 Fundamentals of Speech .....	3	Electives* .....	6
Electives* .....	3	Physical Education .....	1
Physical Education .....	1		17
	17		

### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 327 History & Philosophy of Industrial and Technical Education .....	3	ED 305 Analysis of Technical Education Programs & Course Construction .....	3
PSY 304 Educational Psychology .....	3	ED 344 Secondary Education .....	3
ED 421 Principles and Practices in Industrial Cooperative Training .....	3	Literature Elective .....	3
SOC 401 Human Relations in Industrial Society .....	3	Electives .....	8
Electives* .....	5		17
	17		

### SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 420 Principles of Guidance .....	2	EC 425 Industrial Management .....	3
ED 422 Methods of Teaching Industrial Subjects .....	3	ED 405 Industrial & Technical Education Shop and Laboratory Planning .....	3
ED 444 Student Teaching in Industrial Subjects .....	8	ED 440 Vocational Education .....	2
ED 483 An Introduction to Instructional Media .....	3	Electives* .....	5
PSY 476 Psychology of Adolescence .....	2		13
	18		

Total Hours for Graduation—128

\*Eighteen hours of electives must be selected in accordance with the student's area of specialization and with approval of the adviser. Remaining hours may be taken from free electives.

# TECHNICAL EDUCATION

Poe Hall

The curriculum in technical education is oriented toward achieving the objective of preparing instructors within a wide range of teaching technologies and is closely coordinated with existing engineering curricula. A student enrolling in the technical education curriculum may specialize to some extent in areas related to interest and/or previous work experience. Admission to the technical education curriculum is limited to students capable of demonstrating proficiency in a given applied technology, i.e., electrical, electronics, mechanical, etc.

## OPPORTUNITIES

Many employment opportunities exist for graduates of the technical education curriculum. These include teaching in the expanding community college complex, technical institutes, area vocational schools and within industry as instructors and coordinators of training programs. The growth of technical education in the nation and the large number of new technical education facilities being constructed will require an increasing number of instructors to staff teaching positions.

## TECHNICAL EDUCATION CURRICULUM\*

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I .....	4	EC 205 Economic Activity .....	3
ED 100 Introduction to Industrial Education .....	2	ENG 112 Composition and Reading .....	3
ENG 111 Composition and Rhetoric .....	3	MA 102 Analytic Geometry and Calculus I ..	4
MA 111 Algebra and Trigonometry .....	4	PS 201 The American Governmental System .....	3
Physical Education .....	1	Physical Education .....	1
	<hr/> 14		<hr/> 14

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
E 101 Engineering Graphics I .....	2	PSY 200 Introduction to Psychology .....	3
English Elective .....	3	PY 208 General Physics or	
MA 201 Analytic Geometry and Calculus II .....	4	PY 212 General Physics .....	4
PY 205 General Physics or		Electives** .....	6
PY 211 General Physics .....	4	Physical Education .....	1
Physical Education .....	1		<hr/> 14
	<hr/> 14		

### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 327 History & Philosophy of Industrial and Technical Education .....	3	ED 305 Analysis of Technical Education Programs and Course Construction .....	3
PSY 304 Educational Psychology .....	3	SOC 401 Human Relations in Industrial Society .....	3
SOC 202 Principles of Sociology .....	3	Electives** .....	9
Electives** .....	6		<hr/> 15
	<hr/> 15		

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 405 Industrial & Technical Education Shop and Laboratory Planning .....	3	ED 444 Student Teaching in Industrial Subjects .....	8
ED 422 Methods of Teaching Industrial Subjects .....	3	Electives** .....	7
Electives** .....	9		15
	15	Total Hours for Graduation—116	

\*Student will be expected to demonstrate proficiency in the applied technology of his or her choice—may be fulfilled by technical institute training or selected courses in addition to those required for the degree.

\*\*Minimum of 27 hours of elective courses must be selected from engineering, engineering sciences, physical sciences, etc. in accordance with the student's area of specialization and with approval of the adviser. Remaining hours may be taken from free electives.

## INDUSTRIAL ARTS EDUCATION

Poe Hall

*Associate Professor T. B. YOUNG*

Industrial arts comprises that area of education which concerns itself with materials, processes and products of industry. It is concerned with a study of changes made in materials to make them more useful and with problems related to these changes.

The industrial arts education curriculum at North Carolina State University performs the function of preparing teachers and supervisors of industrial arts for secondary schools.

### FACILITIES

The industrial arts facilities include a drafting room and various laboratories which include test and machine tool equipment for student activities involving wood, metals, plastics, ceramics, electricity and electronics and graphic arts. A separate experimental laboratory is provided for the purpose of encouraging experimentation and applied research in all of the industrial arts areas at the advanced undergraduate and graduate levels.

### OPPORTUNITIES

The graduates of the industrial arts program find excellent opportunities for employment in the public schools as well as in business and industry.

## INDUSTRIAL ARTS EDUCATION CURRICULUM

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I .....	4	ENG 112 Composition & Reading .....	3
ENG 111 Composition & Rhetoric .....	3	IA 105 Drafting .....	4
IA 100 Introduction to Industrial Arts ....	1	MA 112 Analytic Geometry and Calculus A .....	4
IA 102 Fundamentals of Materials & Processes .....	4	PS 201 The American Governmental System .....	3
MA 111 Algebra & Trigonometry .....	4	Physical Education .....	1
Physical Education .....	1		15
	17		

## SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
IA 209 Wood Processing .....	4	EC 205 Economic Activity .....	3
PSY 200 Introduction to Psychology .....	3	IA 210 Metal Technology .....	4
PY 211 General Physics .....	4	PY 212 General Physics .....	4
SOC 202 Principles of Sociology .....	3	Speech Elective .....	3
Physical Education .....	1	Elective* .....	3
	15	Physical Education .....	1
			18

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
IA 205 Industrial Arts Design .....	3	ED 344 Secondary Education .....	3
IA 312 Electricity-Electronics .....	4	ED 482 Curriculum Problems in	
IA 484 School Shop Planning and		Industrial Arts .....	2
Equipment Selection .....	3	IA 304 General Shop Organization .....	2
PSY 304 Educational Psychology .....	3	IA 306 Graphic Arts .....	4
Electives* .....	6	IA 315 General Ceramics .....	3
	19	Literature Elective .....	3
			17

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 420 Principles of Guidance .....	2	History Elective .....	3
ED 422 Methods of Teaching Industrial		IA 465 Independent Study in	
Subjects .....	3	Industrial Arts .....	3
ED 444 Student Teaching in Industrial		IA 480 Modern Industries .....	3
Subjects .....	8	Electives* .....	6
ED 483 An Introduction to Instructional			15
Media .....	3		
PSY 476 Adolescence Psychology .....	2		
	18		

Total Hours for Graduation—134

\*To provide depth of experience in one or two areas of industrial arts, nine additional hours are required in one area or six additional hours in one and three in another.

## MATHEMATICS AND SCIENCE EDUCATION

Poe Hall

*Professor H. E. SPEECE, Head of the Department*

*Professor: N. D. ANDERSON; Associate Professors: J. R. KOLB, H. A. SHANNON;*  
*Assistant Professors: W. M. WATERS JR., L. W. WATSON; Adjunct Assistant*  
*Professor: ANNIE JOHN WILLIAMS*

The Department of Mathematics and Science Education offers a program for preparing undergraduate students as teachers of mathematics and science. The program is designed to provide a broad background in the natural sciences, social sciences and humanities; depth of specialization in mathematics or an area of science; and the development of professional competencies needed by a teacher. There is sufficient flexibility in the program to allow students to meet certification requirements in more than one teaching field. The depth of preparation in the area of specialization will enable students to pursue a program of graduate studies.

OPPORTUNITIES

The demand for well-qualified mathematics and science teachers in our schools and colleges results in excellent opportunities for graduates of the Department of Mathematics and Science Education. The rapid scientific, technological and educational developments during the past few years have accentuated the importance of mathematics and science teaching. These recent developments have resulted in improved working conditions, salaries and new opportunities for graduate study and professional advancement.

MATHEMATICS EDUCATION CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 102 Analytic Geometry & Calculus I . .	4	MA 201 Analytic Geometry & Calculus II . .	4
CH 101 General Chemistry I . . . . .	4	Science . . . . .	3-4
ENG 111 Composition & Rhetoric . . . . .	3	ENG 112 Composition & Reading . . . . .	3
Humanities-Social Science** . . . . .	3	Humanities-Social Science** . . . . .	3
Physical Education . . . . .	1	Physical Education . . . . .	1
ED 101 Orientation . . . . .	0		
	<hr/> 15		<hr/> 14-15

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 202 Analytic Geometry & Calculus III .	4	Mathematics Elective . . . . .	3
or		PY 212 General Physics . . . . .	4
MA 231 Introduction to Linear Algebra* .	3	ST 361 Introduction to Statistics	
PY 211 General Physics . . . . .	4	for Engineers I . . . . .	3
Humanities-Social Science** . . . . .	6	or	
CSC 111 Algorithmic Languages I . . . . .	2	ST 371 Introduction to Probability &	
Physical Education . . . . .	1	Statistics . . . . .	4
	<hr/> 16-17	ED 203 Introduction to Teaching	
		Mathematics-Science . . . . .	3
		Humanities-Social Science** . . . . .	3
		Physical Education . . . . .	1
			<hr/> 17-18

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Speech . . . . .	3	Humanities-Social Science** . . . . .	3
MA 403 Introduction to Modern Algebra .	3	MA 408 Foundations of Euclidean	
Mathematics Elective . . . . .	3	Geometry . . . . .	3
ED 344 Secondary Education . . . . .	3	MA 433 History of Mathematics . . . . .	3
Humanities-Social Science** . . . . .	3	PSY 304 Educational Psychology . . . . .	3
	<hr/> 15	Free Electives . . . . .	3-6
			<hr/> 15-18

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 420 Principles of Guidance*****	2	Linear Algebra***	3
PSY 476 Adolescent Psychology*****	2	Humanities-Social Science**	3
ED 470 Methods of Teaching Mathematics*****	3	Supporting Elective****	3-4
ED 471 Student Teaching in Mathematics*****	8	Free Electives	6
ED 472 Developing & Selecting Teaching Materials in Mathematics*****	2		15-16
	17	Total Hours for Graduation—127	

\*Students who earn "A" or "B" in both MA 102 and MA 201 are advised to take MA 231. Those who make "A" or "B" in MA 231 are advised to take MA 232. Others take MA 202.

\*\*To be selected as follows:

One course in history	3 s.h.
One course in literature	3 s.h.
At least three courses from two or more of these areas:	9 s.h.
Area 1: fine arts	
Area 2: foreign language	
Area 3: religion, philosophy, psychology	
Two courses from two of the following areas:	
economics, sociology, anthropology, political science, geography	6 s.h.

\*\*\*Students must take at least one linear algebra.

\*\*\*\*Supporting electives for which the student has the prerequisites are to be chosen from the following:

CSC 112, 211, 302, 311, 312	EM 200, 211
EC 260, 261	MA 300-level or above
ST 362 or statistics at any 400- or 500-level	IE 353, 401, 402, 403
EE 201, 202	PHI 335
E 101, 207	IA 312
Physics, chemistry or geoscience: 200-level or above.	

\*\*\*\*\*These courses are taken as a block in the professional semester.

## SCIENCE EDUCATION CURRICULUM

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ENG 111 Composition & Rhetoric	3	ENG 112 Composition & Reading	3
MA 102 Analytic Geometry & Calculus I*	4	MA 201 Analytic Geometry & Calculus II*	4
or		or	
MA 112 Analytic Geometry & Calculus A	4	MA 212 Analytic Geometry & Calculus B	3
CH 101 General Chemistry I	4	or	
Humanities-Social Science**	3	ST 311 Introduction to Statistics	3
Physical Education	1	CH 103 General Chemistry II	4
ED 101 Orientation	0	or	
	15	CH 107 Principles of Chemistry*	4
		Biological Science Elective	4
		Physical Education	1
			15-16

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
PY 211 General Physics***	4	PY 212 General Physics***	4
Speech Elective	3	ED 203 Introduction to Teaching Mathematics-Science	3
Earth Science Elective	3	Humanities-Social Science	3
Humanities-Social Science	3	Physical Education	1
Elective	3	Required Science****	6
Physical Education	1		
	17		17

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
PSY 304 Educational Psychology .....	3	ED 344 Secondary Education .....	3
Humanities-Social Science** .....	3	Humanities-Social Science** .....	3
Required Science**** .....	7	Required Science**** .....	7
HI 321 Ancient & Medieval Science .....	3	Elective .....	3
or			
HI 322 Rise of Modern Science .....	3		16
or			
PHI 405 Philosophy of Science .....	3		
	16		

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 475 Methods of Teaching Science*****	3	Humanities-Social Science .....	6
ED 477 Developing & Selecting		Electives .....	3-4
Teaching Materials*****	2	Required Science****	4
ED 476 Student Teaching in Science*****	8		13-14
ED 420 Principles of Guidance*****	2		
PSY 476 Adolescence Psychology*****	2		
	17		

Total Hours for Graduation—127

\*Required of those specializing in chemistry or physics.

\*\*To be selected as follows:

One course in history .....	3 s.h.
One course in literature .....	3 s.h.
At least three courses from two or more of the areas listed: .....	9 s.h.

Area 1: fine arts

Area 2: foreign language

Area 3: religion, philosophy, psychology

Two courses from two of the following areas:  
economics, sociology, anthropology, political science, geography .....

6 s.h.  
\*\*\*Students may elect to take PY 205 and PY 208 or PY 201, 202 and 203 in lieu of PY 211 and PY 212.

\*\*\*\*Students are required to take a minimum of 24 semester hours in one of four areas of specialization (biology, chemistry, physics, or earth science).

\*\*\*\*\*These courses are taken as a block in the professional semester (offered fall semester only in Science Education).

## SPECIALIZATION REQUIREMENTS

(24 hours)

### *Biology:*

Plant Physiology (BO 421) or Vertebrate	
Physiology (ZO 421) .....	4
Genetics in Human Affairs (GN 301) or	
The Principles of Genetics (GN 411),	
Elementary Genetics Laboratory	
(GN 412) .....	3-4
Organic Chemistry (CH 220) .....	4
Plant Life (BO 200) .....	4
or	
Animal Life (ZO 201) .....	4
General Microbiology (MB 401) .....	4
Introduction to Ecology (BO/ZO 360) .....	4

### *Chemistry:*

Organic Chemistry .....	4
Analytical Chemistry .....	4
Physical Chemistry .....	4
MA 202 Analytic Geometry & Calculus III ..	4
Chemistry Electives .....	8

### *Earth Science:*

GY 222 Historical Geology .....	3
At least two of the three areas:	
MY 201 Atmospheric Environment .....	3
or	
MY 411 Introductory Meteorology .....	3
or	
MY 486 Weather & Climate .....	2
PY 223 Astronomy & Astrophysics .....	3
OY 200 (MAS 200) Introduction to	
Marine Environment .....	3
Earth Science Electives .....	14-16

### *Physics:*

PY 223 Astronomy & Astrophysics .....	3
MA 202 Analytic Geometry & Calculus III ..	4
Physics-Mathematics Electives .....	17

# PSYCHOLOGY

Clarence Poe Hall

*Professor H. G. MILLER, Head of the Department*

*Professors:* H. M. CORTER, D. W. DREWES, J. C. JOHNSON, S. E. NEWMAN, R. G. PEARSON; *Professor Emeritus:* K. L. BARKLEY; *Adjunct Professors:* R. M. CHAMBERS, GILBERT GOTTLIEB; *Associate Professors:* J. L. COLE, J. W. CUNNINGHAM, T. E. LEVERE, J. W. MAGILL, B. A. NORTON, J. L. WASIK, B. W. WESTBROOK; *Clinical Associate Professor:* R. B. DUKE; *Assistant Professors:* T. D. GARDNER, J. E. LUGINBUHL, D. H. MERSHON, R. F. RAWLS, F. J. SMITH; *Adjunct Assistant Professors:* BRENDA C. BALL, R. W. OPPENHEIM, MARGARET N. WIEBE

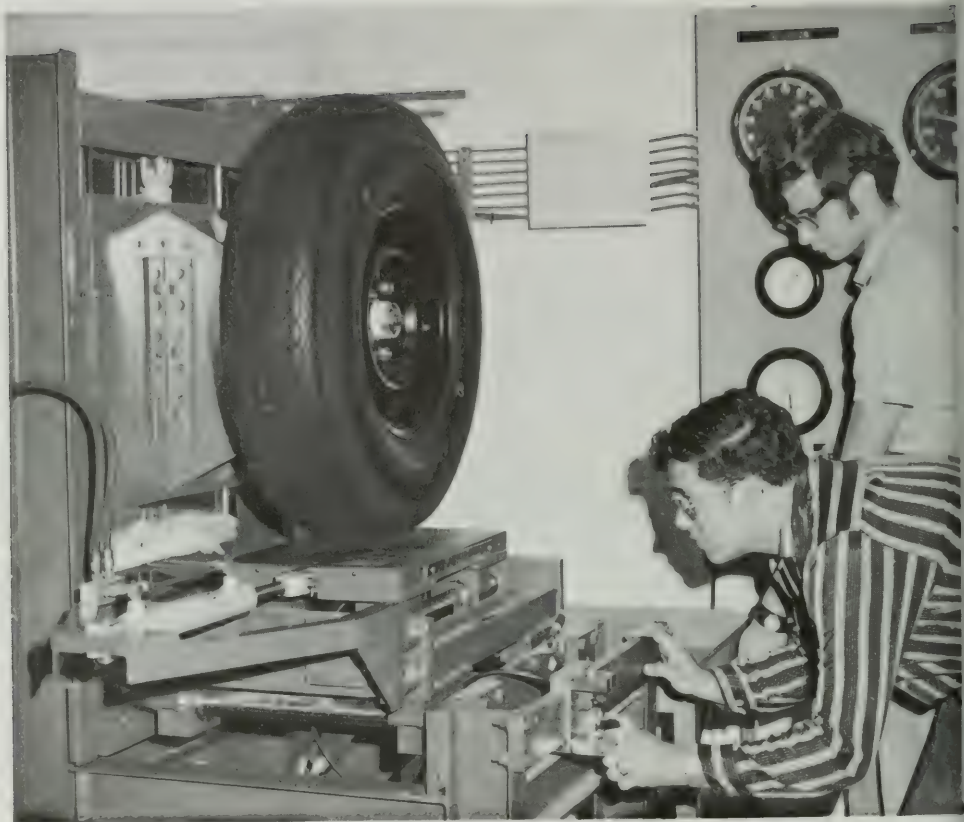
Psychology is one of the basic university disciplines. Mastery of some of the knowledge in psychology is necessary to practitioners in the education, health, social service and managerial professions. An undergraduate major in psychology may lend itself to graduate training in psychology and hence to teaching and research or clinical practice in psychology. Majors in psychology may also enter, graduate study in law, medicine, business, social work or a variety of other fields if they elect the proper courses in their undergraduate curriculum. Students may also choose to enter business or government positions, often without further training beyond the bachelor's degree.

There is a general major in psychology and, in addition to that, there is a special option in human resource development. The general major is designed to be flexible, providing the opportunity for the student to design much of his own curriculum. In accumulating the 124 hours required for graduation the student is required to take two courses in mathematics, three courses in biological and physical science, two courses in composition, and courses in humanities and social sciences. He should take from seven to ten courses in psychology depending on his interests and objectives. The remainder of his courses will be based on what he needs to complete the designed pattern of his education. Much emphasis is placed on the advisory relationship between the student and his faculty adviser.

The human resource development option has as its central concern the preparation of students to enter occupations at the Bachelor of Arts level whose primary function is the fostering of the optimal development and maintenance of human capabilities and the prevention of the loss or diminution of such capabilities. The curriculum designed to prepare these students includes a two year (freshman and sophomore) sequence of courses and experiences in liberal general education. A junior year is devoted to the acquisition of psychological or human development skills and extended experience in those skills through assignment to employment where those skills are fundamental. During the senior year students follow individualized programs of study which grow out of their previous year's skill and work experience. As a consequence of this four year Bachelor of Arts program, students will be qualified to enter human development occupations at a near professional level and they will be motivated to do so. Their other options include entry into graduate school in the psychological and social sciences, entry into other graduate professional schools or entry into positions not requiring highly specialized collegiate undergraduate education.



*The Education Curriculum Center provides assistance to the student enrolled in education. Here a student teacher previews a sound film strip.*



*The undergraduate engineering student is prepared to create goods, services, systems and facilities to meet human needs. Advanced studies offered by most departments provide another opportunity for those wishing to pursue an additional degree.*

# ENGINEERING

Riddick Hall

RALPH E. FADUM, *Dean*

ROBERT G. CARSON JR., *Associate Dean for Academic Affairs*

HENRY B. SMITH, *Associate Dean for Research and Graduate Studies*

JOHN R. CANADA, *Assistant Dean for Extension*

The engineer has the responsibility and obligation to use knowledge in his field for the benefit of mankind. Today, a new sense of responsibility has been imposed upon the engineer because of the impact of science and technology.

Engineering studies are important to those young men and women who look to industry, engineering education, or research and development for a career. These ambitions can well be furthered by the School of Engineering through its undergraduate or graduate programs, where students are offered technical instruction and leadership guidance by an experienced staff of qualified engineers and educators.

The School of Engineering is organized into nine departments: biological and agricultural, chemical, civil, electrical, industrial, materials, mechanical and aerospace, mechanics and nuclear. Undergraduate degree programs are offered in all departments listed. In addition, a degree in engineering operations is offered through a curriculum coordinator. Most teaching departments offer advanced studies leading to the professional degree, the master's degree and the Doctor of Philosophy degree.

A placement office is maintained by the University to assist graduating students and alumni with career development and associated problems.

It is the policy of the School of Engineering to have its curricula more than meet the standards of the Engineers' Council for Professional Development. It is the ambition of the school that these curricula and programs meet the needs of the people and industries of the state and region through effective instruction, competent research and development and worthwhile contributions to engineering knowledge.

## CURRICULA AND DEGREES

The freshman year of the studies is the same for all the engineering curricula. All entering students are assigned to the freshman engineering division where each student is given advice in planning an appropriate program of study. Although the entering student may indicate a curriculum choice if he has one, he may wait until the end of his first year when he is in a better position to judge which engineering branch of study is most suited to his own interests and talents.

**Bachelor of Science in Engineering**—The four-year program provides preparation for graduate school or to meet the needs of young people who will go into industry in the fields of design, development, production, sales, application, and planning and operation of industrial units.

The four-year curricula offer programs of study leading to a bachelor's degree in aerospace, biological and agricultural, chemical, civil, electrical, engineering mechanics, engineering operations, industrial, materials, mechanical and nuclear engineering. Construction engineering is an option in civil engineering. Graduation requirements are the satisfactory completion of the electives and required courses in any one curriculum which amount to 125 to 130 semester hours. A minimum scholastic record of a "C" average is also required.

**Specialized Degree**—A specialized Bachelor of Science degree is also offered through a program of study in furniture manufacturing and management. This four-year curriculum is offered through the Department of Industrial Engineering.

**Joint Liberal Arts-Engineering Program**—Students may wish to take advantage of the opportunity to combine a Bachelor of Science in engineering with either a Bachelor of Science or Bachelor of Arts in liberal arts. When the two are carried along together the double degree program can be completed in five years. Those interested should contact the Freshman Engineering Division and the Dean of Liberal Arts.

**Professional Degree in a Specialized Branch of Engineering**—The professional degree in a specialized branch of engineering is an earned degree which can be obtained after the bachelor's degree.

The curricula are especially designed to meet the needs of students desiring intensive specialization in a particular field or additional course work not ordinarily covered in the normal four-year undergraduate curricula. The professional program of study is offered in chemical, civil, electrical, industrial, materials, mechanical and nuclear engineering.

For detailed information concerning the requirements for the professional degree, turn to pages 174-175.

## HONORS PROGRAM

The Engineering Honors Program is designed to challenge the academically talented student at his level of preparation and ability. While the program has a traditional orientation toward research and graduate study, the qualified student with other career goals or, indeed, still undefined goals is welcome. The opportunities which distinguish the Engineering Honors Program from the standard program of study are: 1) special courses for honors students, 2) individual research or study in collaboration with a professor selected by the student, 3) more personal academic and career advising, and 4) curriculum redesign within liberal guidelines. For details of the program contact the dean's office or the honors adviser in any of the departments of the school.

## COOPERATIVE EDUCATION PROGRAM

A program of Cooperative Education was begun in the school year 1968-69 for the School of Engineering. The program, which is optional, is planned such that the student may alternate semesters of study with semesters of work during the sophomore and junior academic levels. The freshman and senior years are spent on campus while the sophomore and junior academic levels are spread over a three-year period to permit the sandwiching of the academic semesters with practical work experience semesters. The co-op plan requires five years for completion during which time the student receives approximately 18 months of practical experience in his field.

Students in all curricula in the School of Engineering may participate if they have a grade point average of 2.25 or better. After a student has been accepted, he is expected to maintain at least a 2.00 grade-point average to remain in good standing. Application for admission into the co-op program should be made early in the fall semester of the freshman year; however, later applications resulting in fewer work semesters prior to graduation will be considered. Further information may be obtained from the Director of Cooperative Engineering Education, 236 Riddick Building.

## GRADUATE STUDY

A master's degree in a specialized branch of engineering is offered. These are in chemical, civil, electrical, engineering mechanics, industrial and mechanical engineering. The Master of Science and Doctor of Philosophy degrees are offered in all departments of the school. Prospective applicants should consult the Graduate School Catalog.

## RESEARCH

Research activities in the School of Engineering are, in general, related to the educational purposes of graduate studies. A broad spectrum of research activities is engaged in by all departments of the school. The major purposes of these research activities are those of contributing to the scholarly activities of faculty and training graduate students in research. It is intended that these scholarly and research activities be of such a caliber as to result in useful and publishable results.

The State of North Carolina provides research services in areas devoted toward greater utilization of the state's resources. This program is administered through the engineering research services division.

The State of North Carolina also supports a research program at the Minerals Research Laboratory in Asheville, North Carolina. The main purposes of this program are those of assisting in the development of North Carolina's mineral industries. This program is operated by the School of Engineering, but it does not engage in extensive graduate research activities.

## SHORT COURSES AND INSTITUTES

The School of Engineering offers approximately 100 short courses, conferences, workshops, seminars and institutes each year for adults and graduate engineers. These activities are both on the campus and at various centers throughout the State. Such courses vary in length from periodic evening meetings to full-time endeavors of several weeks; each year the courses offered are different and vary according to demand. The engineering faculty usually furnish a large portion of the instruction offered in these courses.

These short courses offer opportunity to practicing engineering personnel to follow a refresher program in their field of interest, as well as to become acquainted with the latest and most modern engineering procedures and equipment.

## HUMANITIES AND SOCIAL SCIENCES

The educated engineer has a foundation in the humanities and social sciences as well as in his technical studies. Each student in the School of Engineering is required to take a minimum of 18 hours of humanities and/or social sciences, approved by his adviser, and made up as follows:

- One beginning course in economics (usually EC 205)
- One beginning course in history
- One beginning course in literature; suggested courses are:
  - ENG 205 Reading for Discovery
  - ENG 262 English Literature II, 1790-Present
  - ENG 266 American Literature II, 1850-Present
- One course in the history or philosophy of science, suggested courses are:
  - HI 341 Technology in History
  - HI 321 Ancient and Medieval Science
  - HI 322 Rise of Modern Science
  - PHI 405 Philosophy of Science
  - UNI 301 Science and Civilization
  - UNI 302 Science and Contemporary Civilization

Other courses may be chosen from any of those on the list below. Students are encouraged to combine one of these courses with others in order to make a two or three course *set*, thus providing depth in one area. Suggested sets are listed to the right of, or below, the course list.

Consideration will be given to courses not on the list if a student has a special interest. In selecting courses the student should check carefully to be sure he has the appropriate prerequisites.

## LIST OF COURSES AND PROPOSED SETS

### *Anthropology Courses*

- ANT 252 Cultural Anthropology
- ANT 305 Peoples of the World

### *Design Courses*

DN 121, 122 History of Design I, II  
PD 321, 322, 421, 422 Colloquium I, II, III, IV

### *Sets*

DN 121, 122  
PD 321, 322  
PD 421, 422

### *Economics Courses*

EC 301 Production and Prices  
EC 302 National Income and Economic Welfare  
EC 370 (HI 370) Rise of Industrialism  
EC 402 Financial Institutions  
EC 410 Public Finance and Fiscal Policy  
EC 413 Competition, Monopoly, and Public Policy  
EC 431 Labor Economics  
EC 440 Economic Development  
EC 442 Evolution of Economic Ideas  
EC 448 International Economics  
EC 470 (HI 470) Evolution of the American Economy  
EC 475 Comparative Economic Systems

With consent of instructor  
EC 205 may be accepted as  
a prerequisite for all  
courses now requiring  
EC 206.

### *Suggested sets, by topic area, are:*

EC 205, 370, 470 Modern industrial nations.  
EC 205, 370, 475 Types of economic organizations.  
EC 205, 470, 475 Types of U.S. economic organization.  
EC 205, 301, 470 Economic analysis of American history.  
EC 205, 301, 410 Economic analysis of the public sector.  
EC 205, 301, 413 Economic analysis of the industrial organization.  
EC 205, 301, 442 Economic analysis and its intellectual origins.  
EC 205, 301, 448 Economic analysis of international economy.  
EC 205, 302, 402 Economic analysis of the U.S. economy.  
EC 205, 302, 440 Economic analysis of the less developed nations.  
EC 205, 301, 431 Economic analysis of labor markets.

### *Genetics Courses*

GN 301 Genetics in Human Affairs  
GN 504 Human Genetics

### *Sets*

GN 301, UNI 303, GN 504

### *History Courses*

All history courses are appropriate.

### *Sets*

Sets can be formed from any  
two history courses falling  
in the same general area or  
time period as the student's  
introductory course in history.

### *Literature Courses*

ENG 346 Comparative Literature I  
ENG 371 The Modern Novel  
ENG 372 Modern Poetry  
ENG 398 Contemporary Literature I, 1900-1940  
ENG 399 Contemporary Literature II, 1940-Present  
ENG 453 The Romantic Period  
ENG 468 American Romanticism  
ENG 469 American Realism and Naturalism  
ENG 485 Shakespeare

### *Sets*

The beginning course plus  
additional literature courses  
from this list.

### *Modern Language Courses*

Any 201 or higher numbered course in any language,  
except MLF 401, 402, MLG 401, 402 and MLS 401, 402,  
is appropriate. Sets can be made up accordingly.  
MLR 303 and 304, Russian Literature in Translation I, II  
do not have any prerequisite and may be chosen.

### *Music Courses*

MUS 200 Music in Contemporary Life  
MUS 210 A Survey of Music in America  
MUS 220 Music of the Romantic Period  
MUS 320 Music of the 20th Century

### *Sets*

MUS 200, 220, 320 (Historical Music)  
MUS 200, 210, 320 (National Music)  
MUS 200, 220, ENG 453 (Music & Literature)  
MUS 200, ART 200, SP 340 (Arts)

### *Philosophy Courses*

PHI 305 Philosophy of Religion  
PHI 306 Philosophy of Art  
PHI 307 Morality and Human Happiness  
PHI 308 Contemporary Moral Philosophy

### *Sets*

PHI 307, 308, 309 and others

PHI 309 Contemporary Political Philosophy  
 PHI 310 Existentialism  
 PHI 405 Philosophy of Science

#### *Politics Courses*

All politics courses are appropriate.

#### *Suggested sets, by topic area, are:*

Urban Politics	PS 206, 494, 520, 521
International Relations	PS 222, 322, 431
Comparative Government	PS 200, 301, 302, 376, 421, 472, 473
Political Development	PS 473, 503, 572, 575
State and Local Government	PS 206, 406, 516
Foreign Policy and Defense Policy	PS 201, 321, 421, 405
Political Theory: Normative and Empirical	PS 200, 391, 500, 501, 505, 515
Policy and Administration	PS 502, 503, 511, 516, 542
The Political Process	PS 401, 461, 502, 531, 533
American Politics	PS 201, 206, 321, 401, 403, 406

#### *Psychology Courses*

PSY 200 Introduction to Psychology	<i>Sets</i>
PSY 210 Psychological Analysis Applied to Current Problems	Sets can be made
PSY 302 Psychology of Personality and Adjustment	up from any of
PSY 411 Social Psychology	these courses.

#### *Religion Courses*

REL 300 Introduction to Religion	<i>Sets</i>
REL 321 Religion in American Life	REL 300, 321, 327
REL 327 Contemporary Religious Thought	

#### *Sociology Courses*

SOC 202 Principles of Sociology	<i>Sets</i>
SOC 301 Human Behavior	Sets can be made
SOC 303 Current Social Problems	up from any of
SOC 304 Contemporary Family Life	these courses.
SOC 305 Race Relations	
SOC 401 Human Relations in an Industrial Society	
SOC 402 Urban Sociology	
SOC 451 Population and Public Affairs	

#### *Speech Courses*

SP 340 Play Production  
 SP 420 Development of Rhetorical Theory  
 SP 430 History and Criticism of American Public Address

#### *University Studies Courses*

UNI 303 Man and His Environment	<i>Sets</i>
UNI 323 World Population and Food Crisis	Sets can be made
UNI 401 Urban Crisis	up from any of
UNI 402 Arms Race	these courses.
UNI 301 Science and Civilization	
UNI 302 Science and Contemporary Civilization	

#### *Courses Concerned with Man and with the Environment*

(See also courses in anthropology, genetics and university studies.)

BO 360 (ZO 360) Introduction to Ecology	<i>Sets</i>
EM-PHI-REL 590 Technology and Human Values	Sets can be made up
FOR 472 Renewable Resource Management	from this list and
FOR 572 Conservation Policy Issues	related courses in
NTR 301 (FS, ANS 301) Nutrition and Man	anthropology, genetics
ZO 400 Biological Basis of Man's Environment	and university studies.
ART 200 The Visual Arts in Contemporary Life	

NOTE: The 18 (21 hours for electrical engineering) hours humanities-social science series are *NOT FREE ELECTIVES*; therefore, by University rules, *CANNOT* be taken on a pass/fail basis. Free elective courses in the Humanities & Social Science field, however, can be taken on a pass/fail basis.

## FRESHMAN ENGINEERING DIVISION

*Associate Professor R. H. HAMMOND, Director*

*Assistant Professor: W. J. VANDERWALL; Senior Advisers: G. K. HILLIARD, B. HOUCK JR.; Instructors: J. L. CROW, G. A. FINLEY, J. F. FREEMAN, E. H. STINSON, B. D. WEBB*

All students in their first year in the School of Engineering are required to take the same general program of courses. The Freshman Engineering Division of the School of Engineering advises all freshman students on academic affairs and arranges a program of courses which best suits one's individual background and talents and permits one the greatest probability of academic success. This division also offers general counseling service to the freshman student.

Although an entering student may designate the curriculum he proposes for his major, it is not necessary for him to decide upon his major until the end of his freshman year. As each student earns 28 or more credits, he is transferred to the department of his choice. This normally is achieved at the end of the spring semester.

The Freshman Engineering Division offers assistance to high schools on questions involving engineering as a career. However, its major function is guiding and counseling each student throughout his freshman year in the School of Engineering.

## TYPICAL FRESHMAN YEAR IN ALL ENGINEERING CURRICULA

	<i>Credits</i>
CH 101 General Chemistry I .....	4
CH 105 Chemistry—Principles and Applications* .....	3
E 101 Engineering Graphics I .....	2
E 120 Engineering Concepts .....	3
ENG 112H Composition and Reading** ...	3
Humanities or Social Science*** .....	3
MA 102 Analytic Geometry and Calculus I .	4
MA 201 Analytic Geometry and Calculus II	4
PY 205 General Physics .....	4
Physical Education .....	2
	<hr/> 32

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\*Those students who intend to major in chemical engineering or who expect to take additional chemistry courses will take CH 107, Principles of Chemistry, instead of CH 105.

\*\*If a grade of "C" or better is not achieved in ENG 112 H, an additional English course is required.

\*\*\*The humanities or social science courses usually suggested are HI 205, Western Civilization Since 1400, or EC 205, Economic Activity.

The program above is typical. Other courses may be substituted, added, or deleted, dependent upon each student's individual background and talents. Individual programs might range from 28 to 35 credits.

## BIOLOGICAL AND AGRICULTURAL ENGINEERING

(Also see agriculture and life sciences.)

David S. Weaver Laboratories

*Professor F. J. HASSLER, Head of the Department*

## TEACHING AND RESEARCH

*Professors:* H. D. BOWEN, J. W. DICKENS (USDA), J. M. FORE, D. H. HOWELLS, W. H. JOHNSON, C. W. SUGGS; *Professor Emeriti:* G. W. GILES, J. W. WEAVER JR.; *Associate Professors:* G. B. BLUM JR., J. D. HESKETH (USDA), R. G. HOLMES, E. L. HOWELL, B. K. HUANG, E. G. HUMPHRIES, W. F. MCCLURE, R. P. ROHRBACH, T. B. WHITAKER (USDA), C. R. WILLEY (USDA), R. E. WILLIAMSON (USDA), E. H. WISER, J. H. YOUNG; *Assistant Professors:* C. F. ABRAMS JR., G. R. BAUGHMAN, F. J. HUMENIK, M. R. OVERCASH, R. W. SKAGGS, R. S. SOWELL; *Associate Members of the Faculty:* D. D. HAMANN, V. A. JONES (Food Science)

## EXTENSION

*Associate Professor:* G. J. KRIZ, *Associate Head in Charge of Extension; Professor Emeritus:* H. M. ELLIS; *Associate Professors:* L. B. DRIGGERS, J. W. GLOVER, W. C. WARRICK, R. W. WATKINS; *Associate Professor Emeritus:* J. C. FERGUSON; *Assistant Professors:* E. O. BEASLEY, R. E. SNEED

Students in biological and agricultural engineering are educated and trained to deal with problems of agriculture that are engineering in nature. Involved are the application of scientific and engineering principles to the conservation and utilization of water and soil, the development of power and labor-saving devices for all phases of agricultural production, the design of structures and equipment for housing and handling livestock and field products, and the processing and marketing of farm products.

## UNDERGRADUATE CURRICULUM

This curriculum, offered in conjunction with the School of Agriculture and Life Sciences, is designed to develop young people capable of engineering leadership in agriculture. Emphasis is placed on basic science courses such as biology, mathematics, mechanics, physics, soils and thermodynamics, which provide a sound background for engineering and agricultural technology. Courses in biological and agricultural engineering are directed to those methods of thought and techniques whereby science can be applied with understanding and judgement to engineering situations in agricultural operations. General agriculture courses are provided in order that the student can better understand the agricultural industry with which he deals.

Since training in biological and agricultural engineering involves two distinct technical fields—agriculture and engineering—this curriculum is a joint responsibility of the two schools and is so administered.

## FACILITIES

The Department of Biological and Agricultural Engineering is housed in the David S. Weaver Laboratories. This complex of buildings, completed in 1970, embodies the most advanced facilities for education and research in the application of engineering to the production and processing of biological material for food and fiber. Included are offices, classrooms, laboratories, shop facilities, and space for the Agricultural Engineering Extension Service.

## OPPORTUNITIES

Persons trained in biological and agricultural engineering are qualified for positions in design, development and research in public institutions and in industry, and for teaching and extension work in institutions of higher education. The curriculum also provides adequate training for postgraduate work leading to advanced degrees. Graduates in this program receive the degree of Bachelor of Science in Biological and Agricultural Engineering.

## BIOLOGICAL AND AGRICULTURAL ENGINEERING CURRICULUM

For the freshman year see page 148.

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 202 Analytic Geometry and Calculus III .....	4	MA 301 Applied Differential Equations I ..	3
PY 208 General Physics .....	4	EM 305 Engineering Dynamics .....	3
EM 205 Principles of Engineering Mechanics .....	3	EE 331 Principles of Electrical Engineering	3
BAE 251 Elements of Biological & Agricultural Engineering .....	3	BS 100 General Biology .....	4
CSC 111 Algorithmic Languages I .....	2	Social Science & Humanities Elective .....	3
Physical Education .....	1	Physical Education .....	1
	17		17

### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EM 307 Mechanics of Solids .....	3	BAE 342 Agricultural Processing .....	4
BAE 391 Electrotechnology in Biological & Agricultural Engineering ...	3	BAE 462 Functional Design of Field Machines .....	3
BAE 361 Analytical Methods .....	3	BAE 381 Structures & Environment .....	3
MAE 301 Engineering Thermodynamics I ..	3	Social Science & Humanities Elective .....	3
SSC 200 Soils .....	4	Free Elective .....	3
	16		16

### SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BAE 451 Agricultural Engineering Design	3	BAE 452 Agricultural Engineering Design	3
BAE 472 Agricultural Water Management .	4	Advised Technical Elective .....	3
Social Science & Humanities Elective .....	6	Free Elective .....	3
Free Elective .....	3	Social Science & Humanities Elective .....	6
	16		15

Total Hours for Graduation .....129

Social science and humanities electives will be taken according to the standard engineering school listing.

## GRADUATE STUDY

The department offers programs of study for the Master of Science, Doctor of Philosophy and Master of Biological and Agricultural Engineering degrees. Prospective applicants should consult the Graduate School Catalog.

## CHEMICAL ENGINEERING

Riddick Hall

*Professor J. K. FERRELL, Head of the Department*

*Professors:* K. O. BEATTY JR., R. P. GARDNER, D. C. MARTIN, E. M. SCHOENBORN JR., J. F. SEELY, V. T. STANNETT; *Professors Emeriti:* R. BRIGHT, W. L. MCCABE; *Adjunct Professors:* H. P. KRAMER, D. M. PREISS, D. R. SQUIRE; *Associate Professors:* H. B. HOPFENBERG, D. B. MARSLAND, E. P. STAHEL; *Assistant Professors:* R. M. FELDER, M. R. OVERCASH, R. W. ROUSSEAU

Chemical engineering is concerned with the design, optimization and control of processes, equipment and plants in which chemical and physical transformations of matter are carried out. Typical industries relying heavily upon chemical engineering include those producing chemicals, polymers, synthetic fibers, metals, drugs, glass, food, gasoline, rocket fuels, paper, soap and cement; those producing energy from nuclear fuels; and those processing materials by methods involving chemical reactions. In addition, progress in pollution abatement and control must come through the application of chemical engineering techniques. The preparation of individuals qualified to pursue careers in such industries as these is the purpose of the curriculum in chemical engineering.

## CURRICULUM

The work of the chemical engineer is extremely diversified and consequently his education must be along broad and basic lines. The spirit of research and experimentation is a vital part of the chemical industry and even those in the undergraduate curriculum need to acquire the sound scientific background essential to original thought and independent accomplishment. The undergraduate curriculum emphasizes the engineering, chemical and economic principles involved in chemical processes and operations. The work in chemistry including inorganic, analytical, physical and organic chemistry is comparable to that usually given to chemists with the exception of a reduction of time devoted to laboratory work. The subjects in mechanics and materials are designed to supply the fundamentals of these branches. The work in the chemical engineering subjects, although distinctly professional in application, is nevertheless basic in character and depends upon a thorough background in mathematics and the sciences. It is designed to develop initiative, sound habits of thought and intellectual curiosity in the student.

Chemical engineers have played a major role in recent major developments. In addition, the special talents developed by chemical engineers are becoming increasingly called upon to tackle problems seemingly unrelated to traditional chemical engineering. Biomedical engineering, pollution abatement and control and engineering for the nations energy requirements are areas where chemical engineering graduates are making significant contributions.

## FACILITIES

The chemical engineering laboratories are provided with pilot plant-type equipment for studying the principles of fluid flow, heat transfer, distillation, absorption, drying, crushing and grinding, filtration, chemical reaction kinetics, etc. Much new equipment has been installed and new and special apparatus is added from time to time to keep the facilities abreast of recent developments in the field. Emphasis is placed on the use of both digital and analog computers in the solution of typical chemical engineering problems. Special equipment for research and instructional purposes is designed and built in the departmental laboratories. In this way students are given first-hand acquaintance with problems relating to the actual design, construction and operation of typical equipment used in industry.

## OPPORTUNITIES

Opportunities for employment in the chemical and pulp and paper industry, in government, atomic energy and allied fields are numerous and varied. Graduates find employment in such fields as research and development; production, operation and maintenance; management and administration; inspection, testing and process control; technical service and sales; estimation and specification writing; consult-

ing and teaching and many others. Students desiring to pursue careers in research and development or in teaching and consulting work are strongly advised to consider graduate training. In fact, the need for persons who have had advanced training in the field beyond the regular four-year program is continually increasing.

## CHEMICAL ENGINEERING CURRICULUM

For the freshman year see page 148.

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 111 Algorithmic Languages I .....	2	Humanities and Social Sciences .....	3
CH 221 Organic Chemistry I .....	4	CH 223 Organic Chemistry II .....	4
MA 202 Analytic Geometry and Calculus III .....	4	CHE 225 Chemical Process Systems .....	3
PY 208 General Physics .....	4	EM 205 Principles of Engineering Mechanics .....	3
CHE 205 Chemical Process Principles .....	3	MA 301 Applied Differential Equations I ..	3
Physical Education .....	1	Physical Education .....	1
	18		17

### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 431 Physical Chemistry I .....	3	CHE 315 Chemical Process Thermo- dynamics .....	3
CH 432 Physical Chemistry Laboratory .....	1	CHE 327 Separation Processes I .....	3
CHE 311 Transport Processes I .....	3	CHE 431 Chemical Engineering Lab. I .....	3
Humanities and Social Sciences .....	3	Humanities and Social Sciences .....	3
MAT 201 Structure and Properties of Engineering Materials I .....	3	Chemistry Elective .....	3
Free Elective .....	3		15
	16		

### SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CHE 316 Thermodynamics of Chemical & Phase Equilibria .....	3	CHE 451 Chemical Engineering Design ...	3
CHE 432 Chemical Engineering Lab II .....	3	Technical Elective .....	3
CHE 495 Seminar in Chemical Engineering	1	Humanities and Social Sciences .....	3
CHE 446 Chemical Process Kinetics .....	3	Free Elective .....	6
Technical Elective .....	3		15
Humanities and Social Sciences .....	3		
	16	Total Hours for Graduation .....	130

## GRADUATE STUDY

The department offers the Master of Science, the Master of Chemical Engineering and the Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.

## CIVIL ENGINEERING

Mann Hall

*Professor D. L. DEAN, Head of the Department*

*Professor* PAUL Z. ZIA, *Associate Head of the Department*

*Professor* H. E. WAHLS, *Graduate Administrator*

*Professors:* M. AMEIN, W. F. BABCOCK, C. R. BRAMER, P. D. CRIBBINS, R. E. FADUM, C. L. HEIMBACH, J. W. HORN, A. I. KASHEF, W. G. MULLEN, C. SMALLWOOD JR., M. E. UYANIK; *Adjunct Professor:* C. L. MANN JR.; *Associate Professors:* G. H. BLESSIS, J. F. ELY, W. S. GALLER, K. S. HAVNER, L. J. LANGFELDER, J. F. MIRZA, G. R. TAYLOR, C. C. TUNG; *Adjunct Associate Professors:* C. P. FISHER JR., S. D. SHEARER JR.; *Assistant Professors:* N. V. COLSTON JR., W. J. HEAD, J. L. MACHEMEHL, J. C. SMITH; *Extension Specialist:* R. F. DEBRUHL; *Instructor:* A. P. CHREST

Civil Engineering is one of the broadest of the various fields of engineering. It is a discipline that has traditionally been concerned with the improvement and control of environment and deals with the planning, design and construction of buildings, dams, bridges, harbor works, water works, water and nuclear power facilities, sewage disposal works, nuclear waste facilities, and transportation systems including highways, railways, waterways, airports and pipe lines. Graduates in civil engineering are in demand by public agencies as well as by private industries. A wide variety of employment opportunities are available for civil engineers which may involve assignments in design offices or in the field, in small communities as well as in large industrial centers.

## OBJECTIVES

It is the primary mission of the Department of Civil Engineering to offer programs of study designed to provide adequate academic preparation to those contemplating a career in the civil engineering profession. To this end, course work at both the baccalaureate and the graduate levels is offered. The undergraduate program is designed to provide a sound general education and at the same time to prepare the student for advanced study in engineering either by the continuation of formal education at the graduate level or by self-study.

## FACILITIES

The Department of Civil Engineering is located in Mann Hall. This building provides offices, drafting rooms and classrooms, as well as laboratory facilities for testing structural materials, large models or full-scale structures, soils and bituminous products, for hydraulic experiments, for studies in airphoto interpretation and photogrammetry, for analysis of small structural models, for chemical and biological tests pertaining to sanitary engineering, and for the investigation of transportation problems. In addition, the facilities of Mann Hall include a student lounge, a computation and cardpunch room, and a departmental library. All of these facilities have been designed to provide for effective teaching and laboratory instruction and to create a scholarly environment.

## UNDERGRADUATE CURRICULA

The Department of Civil Engineering offers two four-year undergraduate curricula; the one, leading to the degree of Bachelor of Science in civil engineering; the other, to the degree of Bachelor of Science in civil engineering, construction option. Both of these curricula have been accredited by the Engineers' Council for Professional Development.

The civil engineering curriculum is a well-balanced program of study providing academic discipline in the pure and applied physical sciences, the humanities and social sciences, and the professional aspects of civil engineering including structural, transportation and sanitary engineering, and soil mechanics and foundations.

The curriculum in the civil engineering construction option is designed to meet the needs of students who are especially interested in the construction phases of

civil engineering. It includes the core course requirements in the physical sciences and the social sciences and humanities as established for all engineering curricula at North Carolina State University. It differs from the civil engineering curriculum in that special emphasis is given to the construction aspects of civil engineering. To this end, the curriculum includes a three semester sequence of courses in cost analysis and control, and construction methods and planning. The courses, unique to this curriculum, are designed to provide academic discipline in the engineering, planning and management aspects of construction.

## CIVIL ENGINEERING CURRICULUM

For the freshman year see page 148.

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
+CE 202 Introduction to Civil Engineering	2	+GY 120 Physical Geology	3
EM 200 Introduction to Mechanics	3	MAT 200 Mechanical Properties of	
MA 202 Geometry & Calculus III	4	Structural Materials	2
PY 208 General Physics	4	EM 301 Solid Mechanics I	3
Humanities & Social Science*	3	MA 301 Differential Equations I	3
Physical Education	1	Humanities & Social Science*	3
	—	Free Elective	3
	17	Physical Education	1
			—
			18

+ May be taken in reverse semesters.

### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 301 Engineering Surveying	3	CE 305 Transportation Engineering I	4
CE 325 Structural Analysis	3	CE 326 Structural Engineering I	4
CE 332 Materials of Construction	3	CE 342 Soils Engineering I	4
CE 382 Hydraulics	4	CE 383 Water Resources Engineering	4
IE 311 Engineering Project Analysis	3		—
	—		16
	16		

### SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Civil Engineering Electives**	6	CE 450 Civil Engineering Design	3
Engineering Science Elective***	3	Civil Engineering Elective	3
Free Elective	3	Free Elective	3
Humanities & Social Science*	3	Humanities & Social Science*	6
	—		—
	15		15

Total Hours for Graduation .....129

\* Humanities and social science courses to be selected from the standard school pattern.

\*\* Two courses selected from: CE 406 Transportation Engineering II  
CE 427 Structural Engineering II  
CE 443 Soils Engineering II  
CE 484 Water Resources Engineering II

\*\*\* Thermodynamics, engineering mechanics, electrical engineering or materials engineering.

## CONSTRUCTION OPTION CURRICULUM

For the freshman year see page 148.

## SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
+ CE 202 Introduction to Civil Engineering .....	2	+ GY 120 Physical Geology .....	3
MA 202 Geometry & Calculus III .....	4	MAT 200 Mechanical Properties of Structural Materials .....	2
PY 208 General Physics .....	4	EM 301 Solids Mechanics I .....	3
EM 200 Introduction to Mechanics .....	3	MA 301 Applied Differential Equations ..	3
Humanities & Social Science .....	3	Humanities & Social Science* .....	3
Physical Education .....	1	Free Elective .....	3
	17	Physical Education .....	1
			18

+ May be taken in reverse semesters.

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 301 Engineering Surveying .....	3	CE 305 Transportation Engineering I	
CE 325 Structural Analysis .....	3	or	
CE 332 Materials of Construction .....	3	CE 383 Water Resources Engineering I ...	4
CE 382 Hydraulics .....	4	CE 326 Structural Engineering I .....	4
IE 311 Engineering Project Analysis .....	3	CE 342 Soils Engineering I .....	4
	16	CE 365 Construction Engineering I .....	4
			16

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 463 Cost Analysis and Control .....	3	CE 460 Construction Engineering Project .	3
CE 466 Construction Engineering II .....	3	CE 464 Legal Aspects of Contracting .....	3
Engineering Science Elective** .....	3	Free Elective .....	3
Free Elective .....	3	Humanities & Social Science* .....	6
Humanities & Social Science* .....	3		15
	15		
		Total Hours for Graduation .....	129

\* Humanities and social science courses to be selected from standard school pattern.

\*\* Thermodynamics, engineering mechanics, electrical engineering or materials engineering.

## PROFESSIONAL STUDY IN CIVIL ENGINEERING

Fifth-year programs of study leading to the professional degree of Civil Engineer are offered in the following specialty fields: sanitary engineering, soil mechanics and foundation engineering, structural engineering and transportation engineering. The fifth-year curricula, which are made up of advanced course work, are offered as a continuation of the four-year undergraduate program and are designed for students who are desirous of becoming technically proficient in one of the specialty fields of civil engineering. The following curricula are illustrative of the fifth-year program of study. It is to be understood, however, that a curriculum for a given student is designed in consultation with his adviser to suit his particular interests.

Regulations governing the professional program are shown on pages 174 and 175.

## SANITARY ENGINEERING

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 571 Theory of Water & Waste Treatment .....	3	CE 572 Unit Operations & Processes in Wastes Engineering .....	3
CE 573 Analysis of Water & Wastes .....	3	CE 598 Civil Engineering Projects .....	2
CE 598 Civil Engineering Projects .....	2	CE 672 Advanced Water & Wastes Treatment .....	4
CE 671 Advanced Water Supply & Waste Water Disposal .....	4	Electives .....	6
Electives .....	3		15
	15		

## SOIL MECHANICS AND FOUNDATION ENGINEERING

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 524 Analysis & Design of Masonry Structures .....	3	CE 544 Foundation Engineering .....	3
CE 525 Matrix Structural Analysis I .....	3	CE 549 Engineering Properties of Soils II .....	3
CE 548 Engineering Properties of Soils I .....	3	CE 642 Advanced Soil Mechanics .....	3
CE 641 Advanced Soil Mechanics .....	3	MA 405 Introduction to Matrices & Linear Transformations .....	3
Elective .....	3	Elective .....	3
	15		15

## STRUCTURAL ENGINEERING

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 525 Matrix Structural Analysis I .....	3	CE 526 Matrix Structural Analysis II .....	3
CE 625 Advanced Structural Design I .....	3	CE 544 Foundation Engineering .....	3
EM 551 Advanced Strength of Materials .....	3	CE 626 Advanced Structural Design II .....	3
MA 405 Introduction to Matrices & Linear Transformations .....	3	EM 552 Elastic Stability .....	3
Elective .....	3	Elective .....	3
	15		15

## TRANSPORTATION ENGINEERING

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 515 Transportation Operations .....	3	CE 516 Transportation Design .....	3
CE 517 Water Transportation .....	3	CE 601 Transportation Planning .....	3
CE 603 Airport Planning & Design .....	3	CE 604 Urban Transportation Planning .....	3
Electives .....	6	Electives .....	6
	15		15

## GRADUATE STUDY

The graduate degrees offered by the civil engineering department are the Master of Civil Engineering, the Master of Science in civil engineering and the Doctor of Philosophy. Prospective applicants should consult the Graduate School Catalog.

## POST-BACCALAUREATE STUDY IN CIVIL ENGINEERING RELATED TO OTHER FIELDS

**Transportation Engineering or City and Regional Planning**—There exists a growing need for the coordination of transportation facilities and land planning and for individuals with competence in both fields. To fulfill this need, an advanced program leading to a post-baccalaureate degree in engineering with a major in transportation engineering, and to the degree of Master of Regional Planning is offered through the combined resources of the Department of Civil Engineering at North Carolina State University and the Department of City and Regional Planning at the University of North Carolina at Chapel Hill. Qualified students have the opportunity to schedule their courses of instruction to enable them to pursue the dual degree.

The program is designed for students who are desirous of becoming technically proficient in both the fields of transportation engineering and city and regional planning. The minimum residence requirements include two academic years plus a summer internship. The curriculum includes the major core courses for both the advanced transportation engineering program and the city and regional planning program, supplementary courses important to both endeavors and a thesis. A bachelor's degree in engineering, including a knowledge of transportation engineering, from an institution of recognized standing is required for admission to the program. Applicants who do not meet these requirements in full may submit their credentials for examination and consideration.

Further information concerning the joint program may be obtained from the Department of Civil Engineering at North Carolina State University or from the Department of City and Regional Planning at the University of North Carolina at Chapel Hill.

**Water Resources**—To meet the need by industry for personnel with training in water supply and the abatement of water pollution, students in the many curricula leading to positions in industry (food processing, textile chemistry, pulp and paper technology, chemical engineering, zoology and others) may consider courses of instruction in sanitary engineering for advanced undergraduate electives and for minor sequences for advanced degrees. Among the courses appropriate for such students are the following: CE 484, Water Resources Engineering II; CE 571, Theory of Water and Waste Treatment; CE 573, Analysis of Water and Wastes; CE 673, Industrial Water Supply and Waste Disposal; CE 674, Stream Sanitation.

In addition to the traditional program in water supply and pollution control, it is possible for students to major in the areas of hydraulics and hydrology. These programs are developed in conjunction with the engineering mechanics and agricultural engineering programs. Further information may be obtained by writing to the Department of Civil Engineering.

## ELECTRICAL ENGINEERING

Daniels Hall

*Professor G. B. HOADLEY, Head of the Department*

*Professor W. D. STEVENSON JR., Associate Head of the Department*

*Associate Professor W. P. SEAGRAVES, Undergraduate Administrator*

*Professors: W. J. BARCLAY, A. R. ECKELS, W. A. FLOOD, N. F. J. MATTHEWS, L. K. MONTEITH, D. R. RHODES, J. STAUDHAMMER, F. J. TISCHER; Adjunct Professors: G. K. MEGLA, CARMEN J. PALERMO; Associate Professors: N. R. BELL, A. J. GOETZE, J. R. HAUSER, M. A. LITTLEJOHN, E. G. MANNING, J. B. O'NEAL JR., W. C. PETERSON; Adjunct Associate Professor: J. J. WORTMAN; Associate Professor Emeriti: K. B. GLENN, E. W. WINKLER; Assistant Professors: W. T. EASTER, J. W. GAULT, T. H. GLISSON, L. R. HERMAN, J. F. KAUFFMAN, G. G. REEVES, A. T. SHANKLE, R. W. STROH; Adjunct Assistant Professor: S. G. BURGESS*

The Electrical Engineering Department includes in its program such specialized fields as communications engineering, computer engineering, electric power engineering, electronics, electronics engineering and microwave engineering. The departmental program educates a student for any of these professional activities by starting with a thorough grounding in engineering science which is followed by fundamental electrical theory and then by advanced subject matter in which the student has considerable freedom of choice. This allows each student to fit his program to his own personal needs and provides the background for success. The student may be preparing for a field such as antennas, radio propagation, automatic control, computers, communications, telemetering, electronics, the design of electrical equipment, the manufacture of electrical equipment, electrical power production, the utilization of electric power, electronics in medicine, instrumentation, solid-state devices or any other one of the vital, fast developing fields using electricity as either muscles or nerves.

## CURRICULUM

The curriculum in electrical engineering includes comprehensive training in mathematics and physics—the fundamental sciences—and adequate training in allied branches of engineering. Most courses are accompanied by coordinated work

in the laboratory and drill in the application of theory by means of carefully planned problems.

Each student has a choice of elective courses in his program. This allows the student to direct his program to suit his own special needs and individual interests. Students who may be qualified for graduate study have an even wider choice of courses and may coordinate their senior year with a plan for graduate study later. Near the end of the sophomore year, each student is asked to consider his electives and to plan a coordinated program of courses suited to his particular needs and interests.

Examinations are given each week to sophomore students in the electrical engineering course. In the junior year, examinations are given every three weeks; and in the senior year, they are given about every five weeks. This decreasing frequency of examinations is intended to encourage the student to assume more and more responsibility for the success of his own program.

## **FACILITIES**

The Department of Electrical Engineering is housed in Daniels Hall. In addition to offices and classrooms this building provides laboratories for the study of servomechanisms and control, electronics and communications, circuits, instrumentation, computers, microwaves, antennas, electromagnetic fields and waves, electric filters and electrical machinery. Also there is a student study room, a shop and a number of research laboratories, especially in semiconductor materials and devices, computers and electromagnetics.

## **GRADUATION REQUIREMENTS**

Requirements for graduation are passing grades in the courses listed in the electrical engineering curriculum, passing 124 credit hours and a grade-point average of 2.00 or better.

Attendance at two professional electrical engineering society meetings, one in the junior year and one in the senior year, is required.

Also a minimum of six continuous weeks of gainful employment is required. This employment may be as laborer, subprofessional or professional assistant in any of the following fields: industrial manufacturing, repair service or sales; industrial engineering; scientific research; engineering or architectural design and drafting; engineering exploration, surveying or reconnaissance; construction of engineering works. Technical work while in military service or for a school does not satisfy this requirement. The student is responsible for obtaining his employment and supplying satisfactory evidence thereof to the department. This evidence will consist of a letter from the employer to the undergraduate administrator setting forth inclusive dates of employment, character of work performed and an evaluation of the student's work.

## **STUDENT ACTIVITIES**

Close coordination with the work of the professional electrical engineering societies is maintained through the Institute of Electrical and Electronic Engineers (IEEE) student branch which meets monthly. Faculty advisers assist the students in bringing to these meetings practicing engineers. The student branch also sponsors departmental activities such as an annual student papers contest and departmental participation in an open house.

An active chapter of Eta Kappa Nu, the national honorary electrical engineering fraternity, undertakes numerous important projects in addition to holding two initiation banquets yearly.

## **ELECTRICAL ENGINEERING CURRICULUM**

For the freshman year see page 148.

## SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 201 Electric Circuits I .....	4	EE 202 Electric Circuits II .....	4
Humanities & Social Science* .....	3	EM 205 Principles Engineering Mechanics .	3
MA 202 Analytic Geometry and Calculus		Humanities & Social Science* .....	3
III .....	4	MA 301 Applied Differential Equations I .	3
PY 208 General Physics .....	4	Physical Education .....	1
Physical Education .....	1		
	16		14

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 303 Electromagnetic Fields I .....	3	EE 304 Electromagnetic Fields II .....	3
EE 314 Electronic Circuits .....	4	EE 305 Electromechanical Systems .....	4
EM 301 Solid Mechanics I		EE 401 Advanced Electrical Circuits .....	3
or		Humanities & Social Science* .....	3
EM 303 Fluid Mechanics I .....	3	Free Elective .....	3
Humanities & Social Science* .....	3		
Free Elective .....	3		16
	16		

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 440 Fundamentals of Digital Systems .	3	ENG 321S The Communication of Technical	
Departmental Elective** .....	3	Information .....	3
Humanities & Social Science* .....	3	Departmental Elective** .....	3
MA, PY or ST Elective .....	3	Humanities & Social Science* .....	3
Free Elective .....	3	MAE 301 Engineering Thermodynamics I .	3
	15	Free Elective .....	3
			15

Total Hours for Graduation .....124

\* A total of 21 hours in the humanities and social sciences, including either UNI 401 or UNI 402, is required. The other hours will be according to the standard school program.

\*\* Chosen from an approved list of EE 400- and 500-level course sequences.

## PROFESSIONAL DEGREE

A fifth or professional year of study is offered in electrical engineering as a continuation of the four-year undergraduate program. This fifth year of study offers specialized and advanced course work leading to the degree of Electrical Engineer. Each student taking this fifth year work plans his program of courses to meet his individual needs. Regulations governing the professional degree are shown on pages 174-175.

## GRADUATE STUDY

The department offers the Master of Science, the Master of Electrical Engineering and the Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.

## ENGINEERING MECHANICS

Riddick Hall

*Professor P. H. McDONALD JR., Head of the Department*

*Professor R. A. DOUGLAS, Associate Head of the Department*

*Professors:* T. S. CHANG, J. A. EDWARDS; *Professor Emeritus:* A. MITCHELL; *Associate Professors:* W. L. BINGHAM, M. H. CLAYTON, E. D. GURLEY, E. G. HUMPHRIES, C. J. MADAY, F. Y. SORRELL JR.; *Assistant Professors:* C. M. CHANG, R. P. GOGOLEWSKI, Y. HORIE, T. E. SMITH JR.; *Adjunct Assistant Professors:* D. I. MCREE, M. T. METTREY; *Instructor:* W. L. LIDDELL JR., J. B. WARE JR.; *Extension Specialist:* H. M. ECKERLIN; *Teaching Technician:* J. B. MILLER

The comprehensive educational programs offered in this department have attracted students with a wide range of interests and career objectives in engineering science from the most practical to the highly theoretical. The several routes to success have been found to contain the common ingredients of: 1) sound basic preparation in the engineering science subjects of mechanics, materials, electromagnetics, thermodynamics, and systems studies, 2) a thorough understanding of the principal technological and scientific ideas on which contemporary society depends for its sustenance and growth, and 3) a curriculum flexible enough to allow the student to pursue his own personal plans to needed levels of professional competence.

In most cases, the students have possessed imagination, creativity, and a generous complement of perseverance as common personal traits, but have also reacted with people and society throughout the spectrum from the extremes of high involvement to individual activity in research.

Graduates of these programs are employed as lone investigators at universities, government laboratories and corporate research establishments. At the present time, a common practice for others is work as a member of a group or team assembled to pursue specific goals and tasks. Still others are self-employed, either as members of professional consulting firms or as managers or owners of business firms in a broad field of activities which includes services, product development and research. A number of these graduates have pioneered in originating and synthesizing new branches of human endeavor both in new areas of knowledge and in new forms of service to society.

## CURRICULUM

At the heart of the curriculum are engineering sciences courses which treat subjects expected to be as viable to engineering practice in the year 2000 as now. To insure the opportunity for individual development in both an engineering sense and a broader sense, the curriculum has been made very flexible through the introduction of a large number of electives. Each student is encouraged and aided in developing a program most suited to his own needs and desires while carefully planned sequences of electives insure that the strength of total program is not sacrificed to momentary interest.

The undergraduate curriculum involves study of the behavior of particles and systems of rigid and deformable solids. It treats fluids, the microscopic and macroscopic behavior of materials, thermodynamics and transport phenomena. Supporting courses introduce electromagnetic circuits and electronics in addition to establishing a strong foundation in mathematics, classical and modern physics, chemistry and humanities and social studies.

For the senior year, this broad program is topped off by any unusual group of synthesis courses in which the student conducts independent studies of his choice in real engineering systems bearing high relevance to the profession and to society.

## FACILITIES

This department is located in the Riddick Laboratories Building. The department has its own precision machine shop in which to make the new devices called for by students in their independent research.

The departmental laboratories are known in the Southeast for the ultramodern

facilities and instrumentation used to demonstrate, explain and explore the phenomena of engineering interest and study.

One example is a hypervelocity gun, capable of accelerating projectiles to velocities near five miles per second, used to study the impact of particles in space. Another is an electromagnetically driven linear pinch device for producing high temperature plasma flows in the Mach<sub>80</sub> to Mach<sub>100</sub> level.

Emphasis is placed on modern instrumentation and the use of such devices as accelerometers, hot wire anemometers, pressure probes, strain gages and associated recording equipment. Interferometry and birefringence, and other optical techniques are used for study of the behavior of solids, fluids and plasmas. The laboratories are equipped with the latest models of pulsed and continuous wave lasers as well as the most modern ultra high speed cameras capable of "freezing" impact phenomena in solids and shock wave radiation phenomena in plasmas.

## ENGINEERING MECHANICS CURRICULUM

For the freshman year see page 148.

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EM 205 Principles of Engineering Mechanics .....	3	EM 305 Engineering Dynamics .....	3
EM 206 Introductory Applications in Mechanics .....	1	MAT 201 Structure and Properties of Engineering Materials I .....	3
MA 202 Analytic Geometry and Calculus III .....	4	MA 301 Applied Differential Equations ...	3
PY 201 General Physics .....	4	PY 202 General Physics .....	4
EE 201 Electrical Circuits I .....	4	Humanities and Social Science** .....	3
Physical Education .....	1	Physical Education .....	1
	17		17

### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EM 307 Mechanics of Solids .....	3	Technical Elective (Stem A)* .....	3
EM 303 Fluid Mechanics I .....	3	Technical Elective (Stem B)* .....	3
MA 401 Applied Differential Equations II ..	3	Technical Elective (Stem C)* .....	3
EM 311 Experimental Engineering Science I .....	3	Free Elective .....	3
Humanities and Social Science** .....	3	Humanities and Social Science** .....	3
	15		15

### SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EM 411 Engineering Cybernetics I .....	3	EM 412 Engineering Cybernetics II .....	3
Technical Elective (Stem A)* .....	3	EM 415 Engineering Science in Contemporary Design .....	2
Technical Elective (Stem B)* .....	3	Free Elective .....	6
Technical Elective (Stem C)* .....	3	Humanities and Social Science** .....	3
Humanities and Social Science** .....	3		
	15		14

Total Hours for Graduation—125

#### \*Technical Elective Stems:

These course will be selected in consultation with the adviser, from several broad interdepartmental groups, according to the individual student's educational objectives. The grouped subject areas include

Stem A: fluid mechanics, thermodynamics, heat and mass transfer.

Stem B: solid mechanics, dynamics, materials.

Stem C: general, such as, mathematics, electronics, electromagnetics, systems, structures, bio-mechanics, geosciences.

\*\*See pages 145-147 for information about the humanities and social science sequence.

## GRADUATE STUDY

The Department of Engineering Mechanics offers the Master of Engineering Mechanics degree, the Master of Science degree and the Doctor of Philosophy degree. Prospective applicants should consult the Graduate School Catalog.

## ENGINEERING OPERATIONS

Riddick Hall

*Assistant Professor W. T. EASTER, Director*

*Engineering Operations is an interdepartmental program of study leading to the Bachelor of Science degree. Courses are offered through the faculties and facilities of the various departments. Policy for the curriculum is set by an advisory committee made up of representatives from engineering departments and is administered by the director.*

Operations—the means by which product and system designs find practical implementation—offer many challenges in today's technological society. Advancing technology, changing economic conditions and increasing sociological and ecological awareness necessitate constant attention to providing needed goods and services in an efficient, economical and safe manner. Meeting such challenges is the realm of the engineering operations graduate. A vital contributor in the overall spectrum of engineering activity, he assumes responsibility where the specialist leaves off. He may be concerned with controlling production, implementing a system, coordinating activity or providing facilities. Alternatively he may seek applications for his company's products as a sales engineer. While these functions are diverse in nature, they share a common requirement: a need for equal competence in technical, business and human concerns.

## CURRICULUM

The Engineering Operations Program strives to meet the needs of operations-oriented engineers through a balanced curriculum well founded in the basic arts, humanities and sciences. The least specialized of the B.S. degree curricula offered by the Engineering School, it provides a thorough grounding in general engineering fundamentals and applications. Additional depth in an area of the student's interest is provided by a technical elective sequence taken in the junior and senior years. Three sequences—ceramics, production and electrical—are presently offered, and others are under consideration. Complementing the technical study, a significant introduction to the concepts and practices of administration rounds out the curriculum. This blending of engineering and business courses and the flexibility of the curriculum are the features which attract most students to Engineering Operations.

## JOINT PROGRAM

A joint program in Engineering Operations (production sequence) with the University of North Carolina at Asheville permits a student to take 86 of the required 128 credits at UNC-A. Upon transferring to North Carolina State University, one can complete the remaining 42 credits in a minimum of one calendar year. Additional details are given in the UNC-A catalog.

## OPPORTUNITIES

Graduates in engineering operations find career opportunities in the engineering functions of industrial production, plant operation, technical sales and technical administration. They may be employed not only by manufacturing companies

but also by service firms such as utilities, contractors, consultants and financial institutions.

Because of the general nature of the curriculum, graduates in engineering operations do not normally take advanced study in engineering. They may, however, pursue graduate degrees in economics, business administration, law and other disciplines not requiring a technically specialized undergraduate preparation.

ENGINEERING OPERATIONS CURRICULUM

For the freshman year see page 148.

SOPHOMORE YEAR

Fall Semester		Credits	Spring Semester		Credits
MA 202	Analytic Geometry & Calculus III	4	CSC 111	Algorithmic Languages I	2
PY 212	General Physics	4	E 207	Engineering Graphics III	2
EM 211	Introduction to Applied Mechanics	3	EM 212	Mechanics of Engineering Materials	3
Humanities or Social Science		3	MAT 201	Structure & Properties of Engineering Materials I	3
Physical Education		1	Humanities or Social Science		3
		15	Physical Education		1
					14

JUNIOR YEAR

Fall Semester		Credits	Spring Semester		Credits
EC 206	The Price System or		IE 301	Engineering Economy	3
EC 426	Personnel Management	3	EC 260	Accounting I—Concepts of Financial Reporting	3
EE 350	Electric Power Utilization in Manufacturing Processes	3	MAE 307	Energy and Energy Transformations	3
IE 328	Manufacturing Processes	3			9
ST 361	Introduction to Statistics for Engineers I	3			
Humanities or Social Science		3			
		15			

SENIOR YEAR

Fall Semester		Credits	Spring Semester		Credits
EC 262	Managerial Uses of Cost Data	3	IE 420	Manufacturing Controls	3
EO 491	Seminar in Engineering Operations	1	Humanities or Social Science		3
Humanities or Social Science		3			6
		7			

TOTAL CREDIT REQUIREMENTS

	Industrial Ceramics		Production Electrical
Basic Curriculum Requirements	98	98	95
Free Electives	12	11	12
Technical Sequence	18	19	18
Hours Required for Graduation	128	128	125

TECHNICAL ELECTIVE SEQUENCES

Junior Year			F	S	Senior Year			F	S
1. Industrial Ceramics: (total 18 credits)					MAT 417 Ceramic Subsystem				
MAT 311 Ceramic Processing I		3	0	Design		0	3		
MAT 312 Ceramic Processing II		0	3	Technical Electives		6	3		
		3	3			6	6		

2. <i>Production:</i> (total 19 credits)				IE 443 Quality Control .....3 0			
IE 332 Motion & Time Study .....	0	4		IE 343 Plant Layout & Materials			
Technical Elective .....	3	0		Handling .....	0	3	
				EC 432 Industrial Relations .....	3	0	
				Technical Elective .....	0	3	
		3	4				
					6	6	
3. <i>Electrical:</i> (total 18 credits)				EE 314 Electronic Circuits .....	4	0	
EE 350 Electrical Power Utilization				EE 336 Industrial Power and			
in Manufacturing Processes, will not				Control Systems .....	0	3	
be taken (3)				EE 440 Fundamentals of Digital			
EE 201, 202 Electric Circuits I, II .	4	4		Systems .....	0	3	
		4	4				
						4	6

## INDUSTRIAL ENGINEERING

Riddick Engineering Laboratories

*Professor C. A. ANDERSON, Head of the Department*

*Professor S. E. ELMAGHRABY, Associate Head of the Department*

*Professors:* J. R. CANADA, R. G. CARSON JR., R. W. LLEWELLYN, R. G. PEARSON;  
*Associate Professors:* R. E. ALVAREZ, R. H. BERNHARD, J. J. HARDER, A. M. KAMAL, ANCO L. PRAK, S. M. SOLIDAY; *Assistant Professors:* G. E. BENNINGTON, M. J. MAGAZINE, H. L. W. NUTTLE, G. E. TUCKER; *Assistant Professor Emeritus:* R. L. COPE; *Instructor:* T. W. MYERS; *Furniture Extension Specialist:* E. L. CLARK

The industrial engineer designs, improves and installs integrated systems of men, materials and equipment. He draws upon specialized knowledge and skill in the mathematical, physical and social sciences, together with the principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from these systems. The industrial engineer may design work and control systems for many diverse activities, such as a hospital, a department store, an industrial enterprise, an insurance office or government functions. His position in an organization is usually as a management adviser and as such he is brought into contact with every phase of the organization. The industrial engineering curriculum has been carefully planned with these functions in mind to prepare the student for both present and future opportunities in the field.

## CURRICULUM

The curriculum blends a basic group of technical courses common to all engineering with specialized courses in the two major areas of industrial engineering—the design of man and machine systems and the design of management control systems. The departmental course offerings stress the mathematical and statistical techniques of industrial systems analysis; the quantitative methodologies of operations research; the use of digital and analog computers as a tool for problem solving and simulations; the economic considerations of alternatives; the control of product quality and production; the specifications of the manufacturing process including the equipment and tooling; and the utilization of biobehavioral engineering principles. The curriculum is accredited by the Engineers Council for Professional Development.

## STUDENT ACTIVITIES

Student organizations within the department include a chapter of the American Institute of Industrial Engineers (AIIE). This student function has demonstrated its caliber by ranking high in the annual student award in competition with AIIE

chapters at other institutions. Departmental and student activities of a professional and social character are sponsored by the organization.

An active chapter of Alpha Pi Mu, the industrial engineering honor society, gives recognition to the outstanding students in the junior and senior classes. The membership annually undertakes projects of value to industrial engineering students and the department.

INDUSTRIAL ENGINEERING CURRICULUM

For the freshman year see page 148.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanities and Social Science* . . . . .	3	EM 205 Principles of Engineering	
MA 202 Analytic Geometry & Calculus III . . . .	4	Mechanics . . . . .	3
MAT 201 Structures & Properties of		Humanities and Social Science* . . . . .	3
Engineering Materials I . . . . .	3	IE 311 Engineering Project Analysis . . . . .	3
PY 208 General Physics . . . . .	4	MA 301 Applied Differential Equations I . . . .	3
Physical Education . . . . .	1	ST 371 Introduction to Probability &	
		Statistics . . . . .	4
	15	Physical Education . . . . .	1
			17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 111 Algorithmic Languages I . . . . .	2	EC 260 Accounting I—Concepts of	
Engineering Mechanics Elective . . . . .	3	Financial Reporting . . . . .	3
Humanities and Social Science* . . . . .	3	IE 352 Work Analysis & Design . . . . .	4
IE 351 Product & Process Engineering . . . . .	3	IE 354 Human Factors Engineering . . . . .	3
IE 353 Statistical Quality Control . . . . .	3	IE 401 Industrial Engineering Analysis I . . . .	3
IE 361 Quantative Methods in Industrial		Free Elective . . . . .	3
Engineering . . . . .	3		16
	17		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 331 Principles of Electrical		Engineering Science Elective . . . . .	3
Engineering . . . . .	3	Humanities and Social Science . . . . .	3
EE 339 Principles of Electrical Engineer-		IE 421 Data Processing &	
ing Laboratory . . . . .	1	Production Control Systems . . . . .	3
Humanities and Social Science . . . . .	3	Advised Technical Elective . . . . .	3
MAE 301 Engineering Thermo-		Free Elective . . . . .	3
dynamics I . . . . .	3		15
Advised Technical Elective . . . . .	3		
Free Elective . . . . .	3		
	16		

Total Hours for Graduation—128

\*See pages 145-147 for information about the humanities sequence.

PROFESSIONAL STUDY

A fifth or professional year of study is offered in industrial engineering by means of specialized and advanced course work. A student may elect a specialty in consultation with his adviser and then develop a program of study which suits his interests. A student may specialize in production engineering, in decision-making processes as related to industrial engineering or in administrative engineering. This fifth year of study leads to the professional degree in industrial engineering. Regulations concerning the professional program are shown on pages 174-175.

GRADUATE STUDY

The department offers advanced degrees in industrial engineering including the Master of Science, the Master of Industrial Engineering and the Doctor of Philosophy degrees.

For further information concerning graduate study in industrial engineering, consult the current Graduate School Catalog.

FURNITURE MANUFACTURING AND MANAGEMENT

Associate Professor ANCO L. PRAK, *In Charge*

In North Carolina the furniture industry ranks third in terms of its dollar volume of sales and second in terms of its employment. In order to meet the increasing demand for furniture products the industry is rapidly changing towards mechanization and more sophisticated management controls.

The furniture manufacturing and management program is the only one of its kind in the United States. The generous support and cooperation of the industry during plant and market field trips gives students an in-depth understanding of manufacturing. The faculty in the furniture program is keeping abreast of industry problems through frequent contacts and through service on committees of the Southern Furniture Manufacturers Association.

Because of the nature of the industry and the cooperation from the manufacturers, the cooperative education program is particularly well suited to the Furniture Manufacturing and Management curriculum.

CURRICULUM

It is the purpose of the curriculum leading to the degree of Bachelor of Science in furniture manufacturing and management to prepare graduates for technical and managerial positions in the industry.

The curriculum stresses the application of engineering and technology to furniture manufacturing. Related subjects such as management, accounting and economic analysis cover the business side of modern furniture production systems.

GRADUATION REQUIREMENTS

In addition to the academic course work, a minimum of six weeks of continuous, gainful employment in a furniture manufacturing plant is required. In general the student should plan to take such employment between his junior and senior years.

STUDENT ACTIVITIES

The industrial engineering department sponsors the Furniture Club which is operated by the students. All students in the curriculum are eligible for membership in the organization. The club brings in speakers from industry and holds social gatherings for the students.

FURNITURE MANUFACTURING AND MANAGEMENT

For the freshman year see page 148.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
E 240 Furniture Graphics .....	3	CSC 111 Algorithmic Languages I .....	2
Humanities and Social Science* .....	3	Humanities and Social Science* .....	3
PY 212 General Physics .....	4	IE 241 Furniture Manufacturing	
SP 231 Expository Speaking .....	3	Processes I .....	3
Physical Education .....	1	ST 361 Introduction to Statistics for	
		Engineering I .....	3
	14	WPS 201 Wood Structure & Properties ...	3
		Physical Education .....	1
			15

SUMMER PRACTICUM WPS 205, 206, 207, 208, 209 .....5 credits

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanities and Social Science* .....	3	IE 301 Engineering Economy .....	3
IE 321 Business Data Processing .....	3	IE 341 Furniture Plant Layout & Design ..	3
IE 332 Motion and Time Study .....	4	IE 443 Quality Control .....	3
IE 340 Furniture Manufacturing		Advised Elective .....	3
Processes II .....	4	Free Elective .....	3
	14		15

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EC 260 Accounting I—Concepts of		EC 426 Personnel Management	
Financial Reporting .....	3	or	
Humanities and Social Science* .....	3	EC 432 Industrial Relations .....	3
IE 420 Manufacturing Controls .....	3	Humanities and Social Science* .....	3
IE 440 Furniture Management Analysis ..	3	Advised Elective .....	3
Advised Elective .....	4	Free Elective .....	6
	16		15

Total Hours for Graduation .....126

\* See pages 145-147 for information about the humanities sequence.

## MATERIALS ENGINEERING

Page Hall

*Professor W. W. AUSTIN JR., Head of the Department*

*Professors: J. R. BEELER JR., A. A. FAHMY, J. K. MAGOR, C. R. MANNING JR., K. L. MOAZED, H. PALMOUR III, H. H. STADELMAIER, R. F. STOOPS; Adjunct Professor: H. M. DAVIS; Associate Professors: R. B. BENSON JR., J. V. HAMME, G. O. HARRELL; Adjunct Associate Professor: G. MAYER; Assistant Professor: R. F. DAVIS; Adjunct Assistant Professor: J. C. HURT*

The primary objectives of the Department of Materials Engineering are the education and professional development of qualified technical and administrative leaders for industries and government agencies involved with the design, development, selection and processing of engineering materials. Typical of the industries served by materials engineers are: aerospace, electrical and electronics, construction, nuclear power and transportation.

## CURRICULA

The undergraduate curriculum is comprised of a common three-year program of fundamental courses followed by a fourth year in which the student may choose one of the following specialty areas: ceramic engineering, metallurgical engineering, polymeric materials, materials processing, or materials engineering (general). A fifth year professional program is available for advanced work and further specialization in these fields.

The graduate program is designed to permit students from a variety of materials-related undergraduate disciplines to engage in advanced study and research leading to the Master of Science or Doctor of Philosophy degrees. Graduate degree research and specialization may be in ceramics, metallurgy or in a broad-based combination of materials-oriented disciplines including materials physics, materials processing or polymeric materials. Further information on the graduate program will be found in the Graduate School Catalog.

## **FACILITIES**

The facilities of the Department of Materials Engineering are housed in Page Hall and in the Burlington Engineering Research Services complex. They include departmental offices, classrooms and extensive laboratory facilities for instructional work and research in the areas of study covered by the department. Typical of the numerous well-equipped laboratories are those for research and instruction in the following subject areas: X-ray diffraction, differential thermal analysis, thermogravimetric analysis, electron microprobe analysis, radiography, metallography, electron microscopy, mechanical behavior of materials and nuclear fuel research.

## **STUDENT ACTIVITIES**

The student branches of the American Ceramic Society and the American Society for Metals, through monthly meeting provide an effective medium for the professional growth of students. Programs include presentation of student papers, guest speakers and social contact between students and staff. Participation in student technical societies acquaints the student with parliamentary and organizational procedures which are of great importance to professional, industrial and civic life. Students are encouraged to attend local, sectional and national meetings of their respective societies. Keramos, the oldest professional engineering fraternity, and Alpha Sigma Mu, honorary metallurgical fraternity, have active chapters in the department. These fraternities are dedicated to the promotion of scholarship, mental achievement and general service to their professional disciplines.

## **OPPORTUNITIES**

Opportunities for materials engineering graduates are broad. A materials engineer may find challenging employment in a wide selection of companies, locations and types of work. Among the more important job opportunities open to materials engineers are those in research and development of new materials urgently needed in the rapidly expanding fields of chemical, mechanical, aerospace, electronic and nuclear technology. With the continued industrial development of the South and particularly the State of North Carolina, new opportunities are constantly developing for materials engineers who will play a vital role in maintaining state and regional progress.

Professional training in materials engineering provides opportunities for employment in industries producing or consuming a wide variety of essential products including metals and alloys, glass in all its forms, enamels and protective coatings for metals, structural clay products such as brick and tile, thermal insulators, electrical insulators, electronic devices, and plastics or polymeric materials. Initial employment upon graduation may be in the fields of research and development, in-plant operation and control, and in technical sales and service. Such employment may lead to positions as research directors, superintendents, production managers and administrative officers.

## **PROFESSIONAL STUDY**

A fifth or professional year of study is offered in materials engineering as an opportunity for post-graduate study. This professional degree program offers specialized advanced course work leading to the professional degree of Materials Engineer. It is especially designed for students planning careers in consulting, production activities or in technical service and sales. Each program of study is designed to suit the needs of the individual. The following is a typical fifth-year program in materials engineering.

Regulations covering professional study are shown on pages 174-175.

TYPICAL PROFESSIONAL PROGRAM IN MATERIALS ENGINEERING

Fall Semester		Credits	Spring Semester		Credits
MAE 402	Heat and Mass Transfer	3	CHE 540	Electrochemical Engineering	3
PY 407	Introduction to Modern Physics	3	MAE 515	Experimental Stress Analysis	3
MAT 500	Modern Concepts of Materials Science	3	MAT 529	Properties of High Temperature Materials	3
MAT 509	High Vacuum Technology	3	MAT 556	Composite Materials	3
MAT 595	Advanced Materials Experiments I	3	MAT 596	Advanced Materials Experiments II	3
		15			15

MATERIALS ENGINEERING CURRICULUM:

For the freshman year see page 148.

SOPHOMORE YEAR			JUNIOR YEAR		
		Credits			Credits
MA 202	Analytic Geometry and Calculus III	4 0	MAE 301 or CH 331	Engineering Thermodynamics I or Introductory	3 0
MA 301	Applied Differential Equations I	0 3	Physical Chemistry	.....or 4	
PY 208	General Physics	4 0	MAT 301	Equilibrium & Rate Processes in Materials Science	0 3
Humanities and Social Science*		3 3	MAT 310	Physical Examination of Materials	3 0
MAT 201	Structures & Properties of Engineering Materials I	3 0	MAT 450	Mechanical Properties of Materials	0 3
EM 205	Principles of Engineering Mechanics	0 3	MAT 411, 412	Physical Principles in Materials Science I, II	3 3
EE 331, 339	Electrical Engineering	0 4	Humanities and Social Science*		3 3
Physical Education		1 1	EM 307	Mechanics of Solids	3 0
CSC 111	Algorithmic Languages I	2 0	Free Elective		0 3
Free Elective		0 3			15 15
		17 17			or 16

SENIOR YEAR					
		Credits			
MAT 401	Materials Processing	3 0	Technical Electives**	3	3
MAT 431	Physical Metallurgy I	3 0	Technical Electives**	0	3
MAT 435	Physical Ceramics I	3 0	Free Elective	0	3
MAT 423	Materials Factors in Design I	0 3			15 15
CHE 325	Introduction to Plastics	3 0			
Humanities and Social Sciences*		0 3			
			Total Credits for a Bachelor of Science		126 or 127

\* Humanities and social science courses will be taken according to the standard pattern for the School of Engineering.  
\*\* Technical electives provide an identifiable specialty sequence in ceramic engineering, metallurgical engineering or materials engineering in general.

MECHANICAL AND AEROSPACE ENGINEERING

Broughton Hall

Professor C. F. ZOROWSKI, Head of the Department

Professor J. C. WILLIAMS III, Associate Head of the Department

Professors J. A. BAILEY, N. W. CONNER, F. R. DEJARNETTE, B. H. GARCIA JR., F. J. HALE, F. D. HART, H. A. HASSAN, R. B. KNIGHT, M. N. OZISIK, J. N. PERKINS, F. O. SMETANA, J. WOODBURN; Professor and Graduate Administrator: J. S.

DOOLITTLE; *Adjunct Professors*: R. M. CHAMBERS, R. W. GRAHAM, J. J. MURRAY; *Professors Emeriti*: H. B. BRIGGS, R. M. PINKERTON; *Associate Professors*: W. E. ADAMS, R. F. BARRETT, H. A. MACKIE, C. J. MOORE JR., J. C. MULLIGAN, L. H. ROYSTER, J. K. WHITFIELD; *Adjunct Associate Professor*: E. C. YATES JR.; *Associate Professor Emeritus*: W. S. BRIDGES; *Assistant Professors*: J. R. BAILEY, J. A. DAGGERHART JR., T. B. LEDBETTER, L. J. PAVAGADHI; *Adjunct Assistant Professor*: G. L. SMITH; *Assistant Professor Emeritus*: T. J. MARTIN JR.; *Instructor*: G. O. BATTON; *Extension Specialist*: A. S. BOYERS

Engineers satisfy human needs through the application of scientific knowledge to convert natural resources and create new technical systems and processes. A prime motivation is to place these results within the economic reach of a vast segment of humanity. To identify and fulfill human needs, the modern engineer requires a sound educational background in basic science, mathematics, technology and the humanities. The gap between the discoveries of science and its application to fulfill the technological needs of society is bridged by engineering science and technology. Departments of engineering are principally concerned with education in these areas of applied science and the development of talents and skills in their application coupled with an understanding of the human and social aspects involved.

Mechanical engineers specialize in the generation of power and the design of machines and processes that apply mechanical and thermal energy to useful purposes. Some areas of application include conventional and nuclear power generation; automotive and turbine engines; heating, air conditioning, and refrigeration; air, sea, and land vehicles, machine tools, home appliances, manufacturing equipment, instrumentation and industrial controls; and pollution abatement systems. Aerospace engineering shares responsibility for many of the areas listed but is principally concerned with the design and the analysis of the performance, stability, and control of modern aircraft, both commercial and private, and space vehicles. They also focus on ground and airborne support equipment; solid, liquid, and electric propulsion systems, and aerodynamics—the interaction between the vehicle and the atmosphere.

Because of the close relationship between mechanical and aerospace engineering, both curricula are administered by the Department of Mechanical and Aerospace Engineering at North Carolina State University. There is close cooperation between the two disciplines in which responsibility for subject areas such as thermodynamics, heat and mass transfer, vibrations, acoustics, fluid mechanics, propulsion and control theory is shared.

## MECHANICAL ENGINEERING CURRICULUM

For the freshman year see page 148.

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EM 205 Principles of Engineering		CSC 111 Algorithmic Languages I	2
Mechanics	3	EM 305 Engineering Dynamics	3
Humanities, Social Sciences*		Humanities, Social Sciences*	
or		or	
Free Elective	3	Free Elective	3
MA 202 Analytic Geometry and		MA 301 Applied Differential Equations	3
Calculus III	4	MAE 216 Elements of Mechanical	
PY 208 General Physics	4	Engineering	3
Physical Education	1	Physical Education	1
	15		15

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>
EE 331 Principles of Electrical Engineering	3
Humanities, Social Sciences*	
or	
Free Elective	3
MAE 301 Engineering Thermodynamics I	3
MAE 305 Mechanical Engineering	
Laboratory I	1
MAE 315 Dynamics of Machines	3
MAT 201 Structure and Properties of	
Engineering Materials I	3
	<hr/> 16

<i>Spring Semester</i>	<i>Credits</i>
EE 332 Principles of Electrical Engineering	3
EM 303 Fluid Mechanics I	3
Humanities, Social Sciences*	
or	
Free Electives	6
MAE 302 Engineering Thermodynamics II	3
MAE 306 Mechanical Engineering	
Laboratory II	1
MAE 316 Strength of Mechanical	
Components	3
	<hr/> 19

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>
Departmental Elective	3
Humanities, Social Sciences*	
or	
Free Electives	6
MAE 401 Energy Conversion	3
MAE 405 Mechanical Engineering	
Laboratory III	1
MAE 415 Mechanical Engineering	
Analysis	3
	<hr/> 16

<i>Spring Semester</i>	<i>Credits</i>
Departmental Elective	3
Humanities, Social Sciences*	
or	
Free Electives	6
MAE 402 Heat and Mass Transfer	3
MAE 416 Mechanical Engineering	
Design	4
	<hr/> 16
Total Hours for Graduation	126

Students may elect to take PY 201, 202 and 203 in place of PY 205, 208. Rearrangement of the schedule of courses to accomplish this will be worked out in consultation with the student's adviser.

\*See pages 145-147 for information concerning the humanities, social science sequence.

## AEROSPACE ENGINEERING CURRICULUM

For the freshman year see page 148.

## SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>
EM 205 Principles of Engineering	
Mechanics	3
Humanities, Social Sciences*	
or	
Free Elective	3
MA 202 Analytic Geometry and	
Calculus III	4
PY 208 General Physics	4
Physical Education	1
	<hr/> 15

<i>Spring Semester</i>	<i>Credits</i>
CSC 111 Algorithmic Languages I	2
EM 305 Engineering Dynamics	3
Humanities, Social Sciences*	
or	
Free Elective	3
MA 301 Applied Differential Equations	3
MAE 250 Introduction to Aerospace	
Engineering	3
Physical Education	1
	<hr/> 15

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 201 Electric Circuits I .....	4	EE 332 Principles of Electrical Engineering 3	
or		EE 333 Principles of Electrical	
EE 331 Principles of Electrical		Engineering Laboratory .....	1
Engineering .....	3	Humanities, Social Sciences*	
and		or	
EE 339 Principles of Electrical		Free Elective .....	3
Engineering Laboratory .....	1	MAE 356 Aerodynamics II .....	4
MAE 301 Engineering Thermodynamics I . 3		MAE 365 Air-Breathing Propulsion	
MAE 355 Aerodynamics I .....	4	Systems .....	4
MAE 361 Aerospace Vehicle Performance . 3		MAE 371 Aerospace Vehicle Structures I . . 3	
MAT 201 Structures & Properties of			18
Engineering Materials I .....	3		
	17		

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanities, Social Sciences*		Departmental Elective .....	3
or		Humanities, Social Sciences*	
Free Electives .....	6	or	
MAE 462 Flight Vehicle Stability		Free Electives .....	9
and Control .....	3	MAE 479 Aerospace Vehicle Design .....	4
MAE 467 Rocket Propulsion .....	3		16
MAE 472 Aerospace Vehicle Structures II . 4			
	16	Total Hours for Graduation .....	129

\* See pages 145-147 for information concerning the humanities, or social science sequence.

## PROFESSIONAL STUDY

A fifth or professional year of study is offered in mechanical engineering for graduates who desire to return to the University for a program of concentrated study in a selected area. This program is intended primarily for practitioners and is, in no sense, a graduate program leading to the usual advanced degrees. The degree of Mechanical Engineer is conferred upon graduates of the fifth-year program.

## GRADUATE STUDY

The Department of Mechanical and Aerospace Engineering offers the Master of Mechanical Engineering degree, the Master of Science degree and the Doctor of Philosophy degree. Prospective applicants should consult the Graduate School Catalog.

## NUCLEAR ENGINEERING

Burlington Engineering Laboratories

*Professor R. L. MURRAY, Head of the Department*

*Professors: J. R. BEELER, T. S. ELLEMAN, R. P. GARDNER, R. F. SAXE, L. R. ZUMWALT; Associate Professors: J. R. BOHANNON JR., C. E. SIEWERT, K. VERGHESE; Assistant Professor: E. STAM; Extension Specialist: J. KOHL; Health Physicist: D. W. MORGAN JR.; Reactor Engineers: J. T. BEARD, F. J. STEINKRUGER*

The field of nuclear engineering is concerned with the engineering aspects of the control, release and utilization of nuclear energy. Nuclear reactors serve many functions: as heat sources for economical electric power plants, as the basis of modern propulsion systems for ships and submarines, as producers of fissionable and radioactive isotopes for a variety of peaceful applications. Nuclear devices

supply auxiliary power and propulsion energy for space vehicles in operation and under development. The purpose of the nuclear engineering program is to educate the individual in those scientific and engineering principles essential for effective and productive contributions in industrial, university and governmental service.

CURRICULUM

Nuclear engineers have the opportunity to work in the areas of nuclear systems research, design, development, testing, operation, environmental protection and marketing. The Bachelor of Science degree program is designed to prepare graduates for positions in industry or government laboratories or for graduate study in the field. The curriculum incorporates basic sciences and engineering, with special emphasis on mathematics and physics, followed by coursework in nuclear science and technology. Attention is given to the engineering design of nuclear reactors and nuclear radiation systems and to energy resources and environmental aspects of nuclear energy.

FACILITIES

Facilities available on campus for nuclear education at the undergraduate level as well as at the graduate level include: heterogeneous enriched uranium reactor, 10 kilowatt, with beam ports, a fast sample transport system, thermal column, and irradiation volume; Cobalt-60 gamma source, 40,000 curies; multichannel analyzers for gamma ray analysis; solid state detectors; Van de Graaff positive ion accelerator with pulsed source; digital computer, IBM System/370, Model 165, analog computer; radiation detection and control laboratory; activation analysis laboratory; and high- and low-level radiochemistry laboratories.

A one-megawatt "PULSTAR" reactor is available for teaching laboratories, research, radiation services and special training programs. This new heterogeneous enriched uranium reactor provides high steady state fluxes and 2200 MW pulses. The reactor facility includes a thermal column, a bulk irradiation facility, sample irradiation tubes and pneumatic tubes.

OPPORTUNITIES

Although the nuclear industry is relatively young, it already represents a major national effort. Reactor development and construction has proceeded at a remarkable pace and will continue to grow as we become increasingly reliant upon nuclear energy as a substitute for energy from fossil fuels. Industrial applications of radiation will accelerate as the economic potential of such methods becomes even more firmly established. There continues to be a substantial need for nuclear engineers, especially by electric utilities, reactor manufacturers and regulatory agencies. Prospects for the future are promising.

NUCLEAR ENGINEERING CURRICULUM

For the freshman year see page 148.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 111 Algorithmic Languages I .....	2	EM 200 Introduction to Mechanics .....	3
Humanities and Social Sciences* .....	3	Humanities and Social Sciences* .....	3
MA 202 Analytic Geometry and		MA 301 Applied Differential Equations I ..	3
Calculus III .....	4	NE 201 Applications of Nuclear Energy ..	3
MAT 201 Structure and Properties of		PY 203 General Physics .....	4
Engineering Materials I .....	3	Physical Education .....	1
PY 202 General Physics .....	4		
Physical Education .....	1		17
	17		

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 331 Principles of Electrical Engineering .....	3	EE 332 Principles of Electrical Engineering .....	3
EM 303 Fluid Mechanics I .....	3	Humanities and Social Sciences* .....	3
MAE 301 Engineering Thermodynamics I .....	3	MA 401 Applied Differential Equations II ..	3
PY 410 Nuclear Physics I .....	4	MAE 303 Engineering Thermodynamics III .....	3
Free Elective .....	3	NE 302 Fundamentals of Nuclear Engineering .....	4
	16		16

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanities and Social Sciences* .....	3	Advised Nuclear Engineering Electives .....	6
NE 401 Reactor Analysis and Design .....	4	Humanities and Social Sciences* .....	3
NE 402 Reactor Engineering .....	4	NE 403 Nuclear Engineering Design Projects .....	2
Advised Technical Elective .....	3	Free Elective .....	3
Free Elective .....	3		14
	17		

Total Hours for Graduation .....129

\* Humanities and social sciences sequence to be taken according to standard pattern for School of Engineering.

## PROFESSIONAL PROGRAM IN ENGINEERING

The School of Engineering offers professional curricula leading to the degrees Chemical Engineer, Civil Engineer, Electrical Engineer, Industrial Engineer, Materials Engineer, Mechanical Engineer and Nuclear Engineer. A program of study is tailor-made to fit the particular needs of each student to help him prepare for a professional career in engineering.

It is the intent of the program to emphasize professional course work rather than research. The curriculum consists of a minimum of 30 credits of course work making up a planned program designed to fit the student's objective. Samples of typical programs may be found under the appropriate departmental curricula.

### ADMISSION

Applicants who hold the bachelor's degree in engineering from recognized colleges will be admitted to the professional program of the School of Engineering upon presentation of official credentials. For unconditional admission, these credentials must show the completion, with a minimum grade-point average of 2.5 (C+), of an amount of undergraduate work in the proposed field of professional study corresponding to that normally required for a bachelor's degree in that field.

Admission on a provisional basis may be granted applicants who do not meet the formal requirements. In case of insufficient preparation, prerequisite courses will be prescribed in addition to the normal program requirements.

Application should be filed in the office of the dean of the School of Engineering at least 30 days in advance of the semester in which admission is sought.

### GENERAL REGULATIONS

The following regulations of the School of Engineering will be observed:

1. An undergraduate enrolled at North Carolina State University who plans to

undertake a professional program and who has fulfilled all requirements for the bachelor's degree except for a few courses, may be permitted to enroll in courses for credit toward the professional degree provided the student has given notice of his purpose to the dean of the School of Engineering.

2. A limited amount of credit to be applied toward the requirements for the professional degree may be transferred to North Carolina State University from recognized institutions of university grade offering advanced work in engineering and related fields. Such a transfer of credit must be recommended by the head of the department in which the student does his major work and approved by the dean of the School of Engineering.

3. Professional students are classified as post-baccalaureate students and are subject to rules and regulations as established and administered by the dean of the School of Engineering.

4. Grades for such completed courses are reported to the dean of the School of Engineering and to the Office of Registration. A minimum grade of "C" must be made in each course to obtain credit. A quality point average of 2.5 (C+) in all course work must be attained to satisfy requirements for a professional degree.

5. Work completed more than six years prior to the date on which the professional degree is to be granted may not be used as credit toward the professional degree, unless approved by the head of the department concerned and the dean of the School of Engineering.

6. Each professional student will be assigned an adviser in the area of work in which he is majoring. The function of the adviser is to assist the student in preparing a program of study and to counsel him in his academic work. The student will be required, with the assistance of his adviser, to prepare a complete plan of study before the end of his first semester in residence. This program of study is subject to the approval of the dean of the School of Engineering.

## ENGINEERING RESEARCH SERVICES DIVISION

Burlington Laboratories Building

*Research Professor* R. F. STOOPS, *Acting Head*

*Assistant Director:* B. M. GAY; *Research Professors:* H. PALMOUR III, H. H. STADELMAIER; *Research Associate Professor:* FRANCES M. RICHARDSON; *Assistant Professor:* R. F. DAVIS; *Research Associates:* K. R. BROSE, A. E. LUCIER; *Research Assistants:* MARIA L. FIEDLER, L. T. JORDAN, G. S. SHEFFIELD

The Engineering Research Services Division is operated within the School of Engineering as a special administrative unit for the following purposes: (1) to offer to industry engineering services devoted to the solution of technical problems, (2) to develop new or improved products and processes that will provide wider utilization of the natural resources of the State, (3) to provide research support services for the academic departments, and (4) to administer the research, training, and equipment grants and contracts of the School of Engineering. To accomplish these objectives Engineering Research Services Division has an administrative section, a metallurgical research section, a ceramic engineering research section, a pyrochemical research section and 11 specialized service facilities. The latter provide special services such as electron microscopy, electron microprobe analysis, X-ray diffraction and fluorescent analyses, thermoanalytic analysis, precision machine shop work, electronic equipment repairs, mechanical testing, etc. The Division's research activities, particularly those involving metals and ceramics, have received national and international recognition. Much needed engineering services have been provided to existing industries, and such services provided by the Division have led to the establishment of new industries in North Carolina.

The School of Engineering's research contracts and grants administered by the

Division had a value of \$2,087,000 during the 1971-72 fiscal year. This research resulted in 225 scientific and technical publications.

## INDUSTRIAL EXTENSION SERVICE

Riddick Building and Daniels Hall

J. R. CANADA, *Assistant Dean of Engineering for Extension*

*Supervisor of Industrial Extension Education:* J. R. HART; *Supervisor of Area Services:* T. W. STEPHENSON; *Supervisor of Information Services:* E. L. BRIGGS JR.; *Engineering Extension Coordinator:* C. S. COOPER; *Media Training Coordinator:* J. E. KIMBRELL; *Project Director:* N. B. ANGEL; *Departmental Extension Specialists:* R. F. DEBRUHL (Civil Engineering), H. M. ECKERLIN (Engineering Mechanics), E. L. CLARK (Industrial Engineering), A. S. BOYERS (Mechanical and Aerospace Engineering), J. KOHL (Nuclear Engineering); *Field Representatives:* W. W. ERWIN, D. E. HARRELL, M. R. SPARKS, J. B. TRAVIS; *Industrial Specialist:* S. D. COWARD, F. L. EARGLE; *Extension Training Specialist:* R. G. SMITH; *Marine Engineering Extension Specialist:* A. G. CHLEBOROWICZ; *Plastics Engineering Extension Specialist:* H. H. HAAXMA

The Industrial Extension Service is the organization designated by the School of Engineering to provide educational, information, referral and technical assistance services to the industrial community in the State. It provides extension education and field services in direct response to expressed industrial needs.

## EXTENSION EDUCATION

The objective of this program is to serve the needs of North Carolina's industry for continuing education through the offering of short courses and conferences, supervisory development workshops, correspondence and evening courses for credit and educational television courses. Also, technical bulletins, directories and packaged in-plant training course materials are prepared and distributed.

## FIELD SERVICES

The objectives of the Field Services Program are to determine the needs and interests of North Carolina's industry and to provide appropriate liaison, referral, informational and technical assistance services. This includes training and technical assistance to small industry, the maintenance and operation of a film lending library, and the maintenance and operation of a lending library of programmed instruction material.

## MINERALS RESEARCH LABORATORY

180 Coxe Avenue

Asheville, North Carolina

W. T. MCDANIEL JR., *Chief Engineer*

*Ore Dressing Engineer:* I. H. REDEKER; *Mineral Dressing Engineers:* E. H. BENTZEN III, R. D. KAUFFMAN, R. M. LEWIS; *Ore Dressing Specialist:* J. P. NEAL; *Chemical Engineer:* P. N. SALES

The Minerals Research Laboratory is operated by the School of Engineering. The primary objectives of the laboratory are: (1) to supply technical assistance to mineral producers of North Carolina through research and development, (2) to aid

in establishing new industries in the State, and (3) to develop, conserve and enhance the value of the mineral resources of North Carolina. Since it was established by the General Assembly in 1946, the laboratory has made important contributions toward the above objectives. An estimated \$100,000,000 has been invested in plants in the State using processes developed at the laboratory.

The principal efforts of the laboratory are in the area of mineral recovery, and in recent years emphasis has been on recovery of valuable minerals from wastes. For example, successful waste utilization programs for the mica and feldspar industries have improved the competitive position of these companies, have reduced pollution and have resulted in conservation of the State's mineral resources. Improved beneficiation methods are being developed for mica, feldspar, phosphate, olivine, chromite, kyanite, limestone, clay, pyrophyllite, talc and ilmenite.

The facilities of the laboratory include the latest equipment for separation and improving the quality of minerals. Materials may be processed in the laboratory in small batches or on a full pilot-plant scale.



# FOREST RESOURCES

Biltmore Hall

ERIC L. ELLWOOD, *Dean*

L. C. SAYLOR, *Assistant Dean*

The management and utilization of the resources and products associated with the forests of the South provide many opportunities for challenging professional careers. Our forests provide a variety of goods such as timber, water, wildlife and recreation environments that are vital to the economy and well being of North Carolina. Students graduating from one of the School's programs are qualified for professional positions managing forest lands, or producing the products or managing the services developed from these lands. The principal thrust of the programs is in the area of natural renewable resource management. The management of forest lands and the wise use of the products and amenities that can be derived from them is central to preserving the quality of the environment and the quality of life for society.

North Carolina is one of the nation's most important forest states. Its 20 million acres of commercial forest land, which comprises two-thirds of the land area of the State, form the base for goods and services valued at approximately five billion dollars annually. Nearly 20 percent of the state's industrial labor force is associated with forest based organizations.

The South, appropriately named the "wood basket" of the United States, contains forests that support the region's largest industry. New wood-using industries continue to move into the South on an unprecedented scale, creating multi-billion dollar outputs for the region. In a similar manner, recreational activities continue to expand at explosive rates as a result of growing population, affluence, mobility and leisure time; this also has developed into a multi-billion dollar industry.

As a result of this growth, the forest based industries, together with a variety of governmental agencies, need a large number of well-educated, technically competent personnel.

Many of the programs in the School of Forest Resources are not duplicated in other southern universities and for this reason the Trustees of the University and the Southern Regional Education Board have designated certain of the School's programs as regional in nature. As a result no limit is set to enrollments of qualified out-of-state students.

## DEGREES

The Bachelor of Science degree is conferred upon the satisfactory completion of any of the four-year undergraduate curricula listed below.

Graduate degrees offered in the School include: Master of Science, Master of Forestry, Master of Recreation Resources, Master of Wood and Paper Science and the Doctor of Philosophy. Interested applicants should consult the Graduate School Catalog for additional information.

## CURRICULA

Six curricula are administered in the School through its Departments of Forestry, Recreation Resources Administration and Wood and Paper Science. These programs, which provide a broad education in the biological and physical sciences as well as a sound cultural background, prepare students for careers in the professional fields of conservation, forestry, natural resource recreation management, recreation and park administration, pulp and paper science and technology, and wood science and technology.

Freshmen enrolling in the School have a nearly common core of courses during the first semester. This allows deferment of the final selection of a curriculum for two or three semesters without penalty. An introductory course given during the

first semester describes all curricula within the School and the career opportunities related to each.

## FIELD INSTRUCTION AND EXPERIENCE

All students (except those in conservation) are required to present an equivalent of one summer of acceptable work experience in order to meet graduation requirements. Students are required to consult with their advisers as to what constitutes acceptable employment.

The sophomore summer camp is a requirement for students in forestry. This camp follows the sophomore year for resident students. Transfer students attend the camp after completing the junior year at North Carolina State University.

Wood science and technology students are required to attend a summer practicum following the sophomore year; transfer students attend following the junior year.

Additional field instruction and scheduled trips to representative industries and agencies are required frequently as a part of regular class assignments.

## HONORS PROGRAM

Students making exceptional academic records during their freshman year may, with the approval of the faculty, elect to follow an honors program. Students enrolled in the program develop more rigorous programs of study, frequently taking advanced courses in such areas as mathematics, chemistry, statistics and economics. With the consent of their adviser, honors students may substitute preferred courses for normally required courses in order to develop programs of strength in special areas of interest. During the junior and senior years, honors students are encouraged to undertake a special program of independent study which can involve a research problem.

## EXTENSION

The Forestry Extension Program, a part of the Agricultural Extension Service, is the largest program of its type in the United States. It serves landowners, industries and public agencies in the areas of forestry, recreation, wildlife and wood and paper. Primary responsibility for the extension service is promoting the application of new ideas developed through research and experience.

In cooperation with the General Extension Division, short courses are offered in a number of fields to provide men in industry and government an opportunity to keep abreast of modern developments in techniques and equipment.

## FACILITIES AND LABORATORIES

The School of Forest Resources is housed in three modernly equipped facilities on the southwest side of the campus. In addition, the School has five research and demonstration forests containing more than 80,000 acres that provide excellent opportunities for field instruction.

*Biltmore Hall*—This \$1,700,000 facility is the most recent addition to the School complex. It contains general classrooms, laboratories, administrative and faculty offices and a library.

*Hodges Wood Products Laboratory*—One of the largest and most completely equipped laboratories for the conduct of training and research in wood technology, this structure houses machining, gluing, finishing, preserving, testing and research laboratories, as well as a sawmill, dry kiln and veneer lathe.

*Robertson Laboratory of Pulp and Paper*—Unique to the South, this wing of Biltmore Hall contains wood preparation, chemistry, pulping, testing and coloring laboratories as well as digesters and a small paper machine.

*School Forests*—The Hofmann forest on the coastal plain and the Hill, Schenck, Hope Valley and Goodwin forests in the Piedmont provide a wide variety of forest types. The permanent Slocum summer camp for sophomores in forestry is located on the Hill Forest, Durham County.

# CONSERVATION

(Also see agriculture and life sciences.)

M. G. COOK, *Major Adviser, School of Agriculture and Life Sciences*

L. C. SAYLOR, *Major Adviser, School of Forest Resources*

Conservation is wise use, perpetuation, or improvement of natural resources—without waste—for the long-term benefit of society. Rapid urbanization and industrialization, plus an increase in population, are bringing increased pressures on the use of land areas for food and fiber, for wood and water and for recreation. These trends have created an acute need for people educated to make sound judgments in the management and use of natural resources.

The School of Forest Resources and the School of Agriculture and Life Sciences, with strong programs in forestry, recreation, wood and paper science, ecology, soils, wildlife and the basic biological sciences, have jointly developed a baccalaureate program in conservation designed to educate individuals who are needed to meet the present day challenges in natural resource management. Although conservation has been correctly termed a philosophy rather than a discipline, resource managers must be well trained in the basic concepts of several disciplines in order to apply this philosophy to problem-solving in a modern society.

## CURRICULUM

Depending on their interests, students can enroll in various departments in either the School of Forest Resources or the School of Agriculture and Life Sciences. All programs in conservation have a certain number of core courses in common; specialty areas or minors are developed through the use of elective courses.

The program in conservation provides a general education of breadth in natural resource management rather than emphasizing technological aspects. Students desiring an education with more professional emphasis frequently combine the conservation program with a second degree. By the proper choice of electives, it is possible for students to obtain a dual degree by meeting the basic degree requirements in fields such as botany, forestry, liberal arts, recreation, soil science, wildlife management and zoology, as well as in conservation.

## CONSERVATION CURRICULUM

FRESHMAN YEAR			
<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ALS 103 Orientation		CH 101 General Chemistry I .....	4
or		ENG 112 Composition & Reading .....	3
FOR 101 (WPS 101) Introduction to		Humanity—Social Science Elective .....	3
Forest Resources .....	1	MA 112 Analytic Geometry & Calculus A ..	4
BO 200 Plant Life		Physical Education .....	1
or			15
BS 100 General Biology .....	4		
ENG 111 Composition & Rhetoric .....	3		
Humanity—Social Science Elective .....	3		
MA 111 Algebra & Trigonometry .....	4		
Physical Education .....	1		
	16		
SOPHOMORE YEAR			
<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 103 General Chemistry II .....	4	BO 200 Plant Life	
GY 120 Physical Geology .....	3	or	
Humanity—Social Science Elective .....	3	ZO 201 Animal Life .....	4
ZO 221 Conservation of Natural		English Elective .....	3
Resources .....	3	Humanity—Social Science Elective .....	3
Free Elective .....	3	SSC 200 Soils .....	4
Physical Education .....	1	Physical Education .....	1
	17		15

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 360 (ZO 360) Introduction to Ecology .....	4	Biological Science Elective .....	3
Conservation Elective .....	4	Conservation Elective .....	3
RRA 241 Recreation Resource Relationships .....	3	Humanity—Social Science Elective .....	3
Humanity—Social Science Elective .....	3	PY 221 College Physics .....	5
ST 311 Introduction to Statistics .....	3	FOR 472 Renewable Resource Management .....	3
	17		17

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Biological Science Elective .....	3	Biological Science Elective .....	3
Conservation Elective .....	3	Conservation Elective .....	3
English Elective .....	3	Humanity—Social Science Elective .....	3
ZO 353 Wildlife Management .....	3	Free Electives .....	6
Free Electives .....	4		15
	16	Total Hours for Graduation .....	128

See agriculture and life sciences pages 66-70 for a summary of required and elective courses.

## FORESTRY

Biltmore Hall

*Professor C. B. DAVEY, Head of Department*

### TEACHING AND RESEARCH

*Professors:* F. S. BARKALOW, JR., R. C. BRYANT, A. W. COOPER, E. B. COWLING, J. W. DUFFIELD, M. H. FARRIER, J. W. HARDIN, C. S. HODGES, JR. (USFS), J. O. LAMMI, T. E. MAKI, G. NAMKOONG (USFS), T. O. PERRY, L. C. SAYLOR, R. R. WILKINSON, B. J. ZOBEL; *Adjunct Professors:* G. H. HEPTING, N. E. JOHNSON, L. J. METZ; *Professors Emeriti:* W. D. MILLER, R. J. PRESTON; *Associate Professors:* L. F. GRAND, W. L. HAFLEY, B. F. SWINDEL (USFS), A. G. WOLLUM II; *Adjunct Associate Professors:* J. W. KOENIGS, E. G. KUHLMAN, C. G. WELLS, *Assistant Professors:* R. C. KELLISON, D. H. J. STEENSEN; *Adjunct Assistant Professors:* R. L. BLAIR, H. T. SCHREUDER; *Instructor:* A. G. MULLIN; *Liaison Geneticist:* R. J. WEIR; *Teaching Technician:* T. V. GEMMER; *Research Associates:* L. W. HAINES, L. G. JERVIS; *Research Assistants:* J. B. JETT JR., W. D. PEPPER (USFS), J. R. SPRAGUE

## EXTENSION

*Professor W. M. KELLER, In Charge of Forest Resources Extension*

*Professor:* J. C. JONES; *Associate Professors:* W. T. HUXSTER, *Leader, Forestry Section,* E. M. JONES, F. E. WHITFIELD; *Assistant Professors:* R. S. DOUGLASS, W. M. STANTON; *Instructor:* A. J. WEBER; *Specialist:* L. H. HARKINS

## CURRICULUM

The forestry curriculum lays the foundation for a general education and provides training in management of forest land resources. This curriculum requires knowledge of basic surveying and use of aerial photographs to prepare maps and to plan forest road locations; knowledge of biology to identify plants and animals and to control their growth and reproduction; knowledge of mathematics and biometry to sample and estimate timber and other resources of the forest; and knowledge of economics and business management to evaluate and handle forest properties as business enterprises.

The forestry curriculum is broad, but emphasizes a solid background in chemistry, physics, mathematics, biology, humanities and social science. It provides a core of general forestry, part of this core being a 10-week camp program in the summer immediately following the sophomore academic year. The camp is conducted in the Piedmont and the mountains of North Carolina. In the junior and senior years, there are courses dealing directly with the growing of forests, the management of forest lands and the economic use of the resources of the forest. At the end of the sophomore year, or the beginning of the junior year, the student chooses one of several areas of specialization and selects appropriate courses to satisfy the credit-hour requirements for that option. Thirty-four credits are provided for the option and free electives.

OPPORTUNITIES

Graduates are in demand by state and federal land-managing agencies, by industrial concerns growing wood as a raw material, and by other organizations and agencies such as the agricultural extension service. Many graduates, after acquiring professional forestry experience, are self-employed as consultants and as operators or owners of forest-related businesses.

FORESTRY CURRICULUM

FRESHMAN YEAR			
<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 200 Plant Life .....	4	CH 103 General Chemistry II** .....	4
CH 101 General Chemistry I* .....	4	ENG 112 Composition & Reading .....	3
ENG 111 Composition & Rhetoric .....	3	FOR 210 Dendrology-Gymnosperms .....	2
FOR 101 (WPS 101) Introduction to		Humanity—Social Science Elective*** .....	3
Forest Resources .....	1	MA 212 Analytic Geometry & Calculus B ..	3
MA 112 Analytic Geometry & Calculus A* ..	4	Physical Education .....	1
Physical Education .....	1		—
	17		16

SOPHOMORE YEAR			
<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ENG 205 Reading for Discovery .....	3	EC 212 Economics of Agriculture .....	3
FOR 211 Dendrology-Angiosperms .....	2	FOR 272 Forest Mensuration .....	3
SSC 200 Soils .....	4	PY 221 College Physics .....	5
WPS 202 Wood Structure & Properties I ..	3	Free Elective .....	3
Free Elective .....	3	Physical Education .....	1
Physical Education .....	1		—
	16		15

SUMMER CAMP		<i>Credits</i>
FOR 204 Silviculture .....	2	
FOR 263 Dendrology .....	1	
FOR 264 Forest Protection .....	2	
FOR 274 Mapping & Mensuration .....	4	
FOR 284 Utilization .....	1	
	—	10

All students select an option by the beginning of the junior year at the latest.

JUNIOR YEAR			
<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ENT 301 Introduction to Forest Insects ...	3	FOR 452 Silvics .....	4
ST 311 Introduction to Statistics .....	3	Humanity—Social Sciences Electives*** ..	6
FOR 219 (WPS 219) Forest Economy		Option Requirements .....	3
Its Operation .....	3	PP 318 (FOR 318) Forest Pathology .....	4
Humanity—Social Science Elective*** ..	3		—
Option Requirements .....	4		17
	16		

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
FOR 405 Forest Land Management .....	5	FOR 406 Forest Land Inventory	
Option Requirements .....	8	and Planning .....	6
Free Electives*** .....	3	Option Requirements .....	10
	16		16
		Total Hours for Graduation .....	139

\*The freshman year course offerings as shown here assume that entrance test scores suggest readiness for MA 112 and CH 101. Appropriate substitutions will be made when test scores indicate the need to start at a different level.

\*\*Students planning to take full-year courses in advanced chemistry will take CH 107 in place of CH 103.

\*\*\*Electives must include at least 12 credits in humanities or social science; nine credits are completely free of restriction.

## FORESTRY FIELDS OF SPECIALIZATION

The fields of specialization (options) in forestry include (a) general forestry, (b) business operations, (c) forest biometry, (d) watershed management, (e) forest biology, (f) wildlife management, (g) harvesting operations, (h) recreation, (i) conservation and (j) wood technology.

A student selects one of the above fields and schedules the approved courses in that specialization.

## DUAL DEGREE PROGRAMS

Programs have been arranged with the Departments of Economics, Entomology, Recreation Resources Administration, Soil Science, and Zoology, whereby interested students can obtain, in addition to the Bachelor of Science degree in forestry, a second Bachelor of Science degree in agricultural economics, conservation, entomology, natural resource recreation management, soil science or wildlife management. These joint programs usually require some additional credits above the option and free elective credits in the forestry curriculum. Superior students can carry these additional credits in the regular four-year program and average students usually can qualify for both degrees by enrolling for an extra semester or equivalent summer sessions.

## HONORS PROGRAM

An honors program is available for students with outstanding records, who may, with the approval of the faculty, substitute a program of advanced studies in lieu of option requirements and certain core courses.

## RECREATION RESOURCES ADMINISTRATION

Biltmore Hall

*Professor* THOMAS I. HINES, *Head of the Department*

*Professor:* W. E. SMITH; *Associate Professors:* G. A. HAMMON, L. L. MILLER, R. E. STERNLOFF, C. C. STOTT, M. R. WARREN JR.; *Adjunct Associate Professor:* J. S. STEVENS JR.; *Adjunct Assistant Professors:* J. H. BRENDLE JR., J. H. MOSES; *Instructor:* H. K. CORDELL

Standards that have been adopted by the recreation profession make college graduation a requirement for professional employment in the expanding fields of recreation. It is vitally important for the high school graduate who is planning to enter the recreation profession to select wisely a college or university—one that has facilities, staff, curriculum, program and an established reputation for comprehensive professional education in recreation and parks education.

The curricula of the Department of Recreation Resources Administration offer a broad general education background, basic professional and technical courses, and the opportunity for a student to specialize in a particular field of recreation. Two curricula are available: recreation and park administration and natural resource recreation management.

## RECREATION AND PARK ADMINISTRATION

*Professor* THOMAS I. HINES, *In Charge*

### CURRICULUM

The curriculum of recreation and park administration is designed to fulfill the needs of the graduate who will be employed by municipalities, governmental agencies, private agencies, industry and business and other private groups. The general education requirements include courses in biology, psychology, history and government, English, mathematics, chemistry and economics. Courses of a more specialized nature consist of accounting, statistics, research methods, landscape gardening and design. Professional courses, applying directly to the needs of the recreator and his profession, cover such topics as recreation philosophy, management techniques and skills, fiscal operation, supervision, site planning, programming, administration, etc.

To provide a student with the opportunity to study the application of recreation to a particular environment, the following options are available:

*Employee Option*—A background in economics, personnel management and industrial psychology is necessary.

*Municipal Parks*—Additional courses in applied biology, municipal government and community organization are required.

*Institutional*—Youth service agencies, corrective institutions and private agencies require that a graduate have emphasis in sociology and psychology.

*Public*—To satisfy the needs of students planning to be employed by municipalities or counties, additional courses are required in government, community organization and leadership.

## RECREATION AND PARK ADMINISTRATION CURRICULUM

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BS 100 General Biology .....	4	EC 205 Economic Activity .....	3
ENG 111 Composition & Rhetoric .....	3	ENG 112 Composition & Reading .....	3
FOR 101 Introduction to Forest Resources .	1	SOC 202 Principle of Sociology .....	3
MA 112 Analytic Geometry & Calculus A or		BO 200 Plant Life or	
MA 122 Mathematics of Finance &		ZO 201 Animal Life .....	4
Elementary Statistics .....	4	Physical Education .....	1
RRA 152 Introduction to Recreation .....	3	Electives .....	3
Physical Education .....	1		
	16		17

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
RRA 215 Maintenance & Operations I ....	3	CH 111 Foundations of Chemistry .....	5
RRA 241 Recreation Resource		FOR 273 (WPS 273) Quantitative	
Relationships .....	3	Methods of Forest Resources .....	3
Social Science—Humanity Elective .....	3	Physical Science Elective .....	3
Speech Elective .....	3	RRA 216 Maintenance & Operations II ....	3
ZO 221 Conservation of Natural		Social Science—Humanity Elective .....	3
Resources .....	3	Physical Education .....	1
Physical Education .....	1		
	16		18

JUNIOR YEAR			
<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
HS 342 Landscape Horticulture .....	3	EC 260 Accounting I—Concepts of Financial Reporting .....	3
LAR 211 Introduction to Landscape Architecture .....	3	RRA 359 Recreation & Park Supervision ..	3
RRA 358 Recreation Program .....	4	ST 311 Introduction to Statistics .....	3
Social Science—Humanity Elective .....	3	Option Elective .....	3
Sociology Elective .....	3	Elective .....	3
	16		15

SUMMER SESSION (9 weeks)	
RRA 475 Recreation and Park Internship .....	9

SENIOR YEAR			
<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 360 (ZO 360) Introduction to Ecology .....	4	RRA 451 Facility & Site Planning .....	3
RRA 453 Administrative Policies & Procedures .....	3	RRA 454 Recreation & Park Finance .....	3
SOC 416 Research Methods .....	3	Option Elective .....	3
Option Elective .....	3	Elective .....	3
Elective .....	3	Social Science—Humanity Elective .....	3
	16		15
		Total Hours for Graduation .....	138

## NATURAL RESOURCE RECREATION MANAGEMENT

*Associate Professor G. A. HAMMON, In Charge*

### CURRICULUM

A strong upward trend in natural resource-oriented recreation is evident throughout the nation. The demand is exceeding the supply in many localities under existing management conditions and constraints, while inadequately managed use in popular locations is contributing toward progressive and unacceptable depreciation of the physical environment and of the recreation opportunities.

Growing pressure on the diminishing resources base is placing a premium on managers who can recognize opportunities, identify problems, conceptualize solutions and implement policies in this field. Specifically needed are highly motivated professionals with strong interdisciplinary backgrounds who are trained to understand the recreation wants and needs of people, and are competent to make sound judgments in planning and managing renewable natural resources for the optimum output of recreation benefits.

It is the intent of this curriculum to provide professional competence in the field of natural resource recreation management for the student who expects to serve with organizations, institutions, agencies or corporations concerned with the preservation, wise use and improvement of recreation resources and opportunities as they occur in the general forest environment. Students will be better prepared to serve with public or private agencies primarily concerned with the more intensive phases of public outdoor recreation as they occur on extensive parklands and on other nonurban lands managed for the optimum output of diversified recreation opportunities.

NATURAL RESOURCE RECREATION MANAGEMENT CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BS 100 General Biology .....	4	EC 205 Economic Activity .....	3
ENG 111 Composition & Rhetoric .....	3	ENG 112 Composition & Reading .....	3
FOR 101 Introduction to Forest Resources .....	1	MA 212 Analytic Geometry & Calculus B ..	3
MA 112 Analytic Geometry & Calculus A ..	4	ZO 201 Animal Life or	
RRA 152 Introduction to Recreation .....	3	BO 200 Plant Life .....	4
Physical Education .....	1	SOC 202 Principles of Sociology .....	3
	16	Physical Education .....	1
			17

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I .....	4	CH 103 General Chemistry II .....	4
RRA 241 Recreation Resources Relationships .....	3	ENG 205 Reading for Discovery .....	3
ZO 221 Conservation of Natural Resources* .....	3	Social Science—Humanity Elective .....	3
FOR 273 Quantitative Methods in Forest Resources .....	3	PY 221 College Physics .....	5
RRA 241 Recreation Resources Relationships .....	3	Physical Education .....	1
Social Science—Humanity Elective .....	3		16
Physical Education .....	1		
	17		

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
RRA 440 Recreation Resources Inventory and Planning .....	3	RRA 441 Recreation Resources Development .....	3
BO 360 (ZO 360) Introduction to Ecology ..	4	BO 403 Systematic Botany or	
ST 311 Introduction to Statistics .....	3	FOR 210 & 211 Dendrology** .....	4
Controlled Elective .....	6	SSC 200 Soils .....	4
	16	Controlled Elective .....	3
		Elective .....	3
			17

SUMMER SESSION

RRA 475 Recreation & Park Internship ... 9

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
RRA 442 Wildland Recreation Environment .....	3	RRA 454 Recreation & Park Finance .....	3
Controlled Elective .....	6	Controlled Electives .....	6
Social Science—Humanity Elective .....	3	Electives .....	6
Elective .....	3		15
	15	Total Hours for Graduation .....	138

\* Students of junior standing may elect FOR 472, Renewable Resource Management.  
\*\* FOR 210 and 211 may not be taken in the same semester.

WOOD AND PAPER SCIENCE

Biltmore Hall

Professor I. S. GOLDSTEIN, Head of the Department

TEACHING AND RESEARCH

Professors: R. M. CARTER, E. B. COWLING, E. L. ELLWOOD, C. A. HART, R. G. HITCHINGS, R. J. THOMAS; Adjunct Professor: W. R. SMITH; Professor Emeritus:

A. J. STAMM; *Associate Professors*: J. S. GRATZL, M. P. LEVI, W. T. MCKEAN JR., R. G. PEARSON, R. H. REEVES, C. N. ROGERS; *Adjunct Associate Professors*: K. P. KRINGSTAD, R. K. STEVENS; *Associate Professor Emeritus*: C. G. LANDES; *Assistant Professors*: HOU-MIN CHANG, R. C. GILMORE, D. L. HOLLEY JR., M. W. KELLY, D. H. J. STEENSEN; *Assistant Professor Emeritus*: H. D. COOK; *Instructor*: A. G. MULLIN; *Teaching Technician*: T. GEMMER; *Associate Members of the Faculty*: V. T. STANNETT (Chemical Engineering), A. PRAK (Industrial Engineering)

## EXTENSION

*Professor*: A. C. BAREFOOT JR., *Leader, Wood Products Section*; *Associate Professor*: M. P. LEVI; *Associate Professor Emeritus*: L. H. HOBBS; *Assistant Professor*: F. J. HILL; *Instructors*: E. L. DEAL JR., S. J. HANOVER

The wood industries have been a vital part of the economy of North Carolina for over 300 years. North Carolina ranks first in the nation in the manufacture of hardwood, plywood and wooden furniture, first in the South in rough lumber and railroad tie production and among the leaders in the manufacture of pulp and paper. The value of forest products produced annually in the state exceeds three billion dollars. Seventeen percent of the state's labor force is employed in the wood industries.

The Department of Wood and Paper Science offers two curricula—wood science and technology and pulp and paper science and technology—to educate persons for careers in the wood based and allied industries or in government agencies concerned with wood resources. The program in wood science and technology is concerned with the technical aspects of wood and its processing into reconstituted and manufactured products. The pulp and paper science and technology program deals specifically with wood fibers and their processing for paper and wood based chemicals.

## PULP AND PAPER SCIENCE AND TECHNOLOGY

Robertson Laboratory

*Professor* R. G. HITCHINGS, *In Charge*

The curriculum in pulp and paper prepares people for technical work in the rapidly growing pulp and paper industry. Graduates find challenging careers as process engineers, product development engineers, technical service engineers, quality control supervisors, control chemists and production supervisors. After a thorough background in the basic sciences, the program offers laboratory work in the specialized Robertson Pulp and Paper Laboratory in wood pulp processes, chemical and by-products recovery, pulp bleaching, and in the various papermaking operations, such as refining, sizing, filling, dyeing, formation, coating and the converting of paper.

The pulp and paper industry ranks fifth among all American industries. Pulp and paper products are valued at over \$20 billion annually, and the industry provides work for about 700,000 employees. This is primarily a southern industry with over 60 percent of the nation's pulpwood produced in the South.

Financially supported by more than 90 company members of the Pulp and Paper Foundation, this program in pulp and paper was created to meet the critical need for trained persons in the South. It is a regional program and has been approved by the Southern Regional Education Board as the undergraduate program to serve the Southeast in this field. Approximately 50 undergraduate scholarships are granted annually to students pursuing this field of study. The Reuben B. Robertson Pulp and Paper Laboratory provides this program with outstanding and unique facilities.

All students majoring in this curriculum are required to spend at least one summer working in a pulp or paper mill where arrangements have been made by

the University for such employment. One hour of academic credit is granted the student after completion of 12 weeks of mill work and presentation of a satisfactory report covering this work experience. In addition to this minimum summer work requirement, students are urged to work in mills the two remaining summers between academic years because of the great value of practical experience in this industry.

This curriculum leads to the degree of Bachelor of Science in pulp and paper science and technology. Three options are available enabling the student to orient his program to emphasize the technological, engineering or scientific aspects of pulping and papermaking. The technology option provides a broad background for those students anticipating careers in mill operations or with paper industry supplier organizations. Greater depth in the underlying scientific principles or their applications can be obtained from the science and engineering options, which also provide a good foundation for graduate study. A fifth year program leading to a second degree, i.e., a Bachelor of Science in Chemical Engineering, is available for interested students.

## PULP AND PAPER SCIENCE AND TECHNOLOGY CURRICULUM

### TECHNOLOGY OPTION

FRESHMAN YEAR			
<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I .....	4	CH 107 Principles of Chemistry .....	4
ENG 111 Composition and Rhetoric .....	3	ENG 112 Composition and Reading .....	3
MA 112 Analytic Geometry & Calculus A* ..	4	WPS 242 Fiber Analysis .....	3
WPS 101 (FOR 101) Introduction to		MA 212 Analytic Geometry & Calculus B* ..	3
Forest Resources .....	1	E 101 Engineering Graphics I .....	2
Social Science—Humanity Elective** .....	3	Physical Education .....	1
Physical Education .....	1		—
	16		16

\* Honors students take MA 102, 201 and 202  
 \*\* Basic economics course recommended

SOPHOMORE YEAR			
<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 220 Introductory Organic Chemistry ..	4	CH 315 Quantitative Analysis .....	4
PY 211 General Physics* .....	4	PY 212 General Physics* .....	4
ST 361 Introduction to Statistics for		WPS 273 Quantitative Methods in Forest	
Engineers I .....	3	Resources .....	3
Physical Education .....	1	Social Science—Humanity Elective .....	3
Social Science—Humanity Elective .....	3	Physical Education .....	1
Free Elective .....	3		—
	18		15

\* Honors students take PY 205, 208

JUNIOR YEAR			
<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 331 Introduction to Physical Chemistry	4	Engineering Elective* .....	3
CHE 301 Elements of Chemical		CHE 302 Elements of Chemical	
Engineering .....	3	Engineering .....	3
WPS 211 Pulp & Paper Internship .....	1	WPS 322 Pulp & Paper Technology .....	3
WPS 321 Pulp and Paper Technology .....	3	WPS 332 Wood and Pulping Chemistry ..	4
WPS 331 Introduction to Wood and Pulping		Free Elective .....	3
Chemistry .....	1		—
MAE 307 Energy Transformations .....	3		16
Social Science—Humanity Elective .....	3		
	18		

\* EE 331 or 350 or IE 301 or CHE 225

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
WPS 471 Pulp/Process Analysis .....	3	WPS 403 Paper Process Analysis .....	3
WPS 411 Pulp/Paper Unit Processes ....	3	WPS 412 Pulp/Paper Unit Processes ....	3
WPS 491 (FOR 491) Senior Problems in Forest Resources .....	1	WPS 463 Plant Inspections .....	1
Social Science—Humanity Elective .....	3	Social Science-Humanity Elective .....	3
WPS 413 Paper Properties & Additives ....	3	Free Elective .....	3
Technical Elective .....	3	Technical Elective .....	3
	16		16
		Total Hours for Graduation .....	131

## PULP AND PAPER SCIENCE AND TECHNOLOGY CURRICULUM

### SCIENCE OPTION

#### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ENG 111 Composition & Rhetoric .....	3	ENG 112 Composition and Reading .....	3
CH 101 General Chemistry I .....	4	CH 107 Principles of Chemistry .....	4
MA 102 Analytic Geometry & Calculus I ..	4	MA 201 Analytic Geometry & Calculus II ..	4
WPS 101 (FOR 101) Introduction to Forest Resources .....	1	E 101 Engineering Graphics I .....	2
Social Science—Humanity Elective* .....	3	WPS 242 Fiber Analysis .....	3
Physical Education .....	1	Physical Education .....	1
	16		17

\*Basic economics course recommended

#### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I .....	4	CH 223 Organic Chemistry II .....	4
MA 202 Analytic Geometry & Calculus III ..	4	MA 301 Applied Differential Equations I ..	3
PY 205 General Physics .....	4	PY 208 General Physics .....	4
Social Science—Humanity Elective .....	3	Free Elective .....	3
Physical Education .....	1	Physical Education .....	1
	16		15

#### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 431 Physical Chemistry I .....	3	CH 433 Physical Chemistry II .....	3
CH 432 Physical Chemistry Laboratory ....	1	CH 434 Physical Chemistry II Laboratory ...	2
WPS 211 Pulp and Paper Internship .....	1	WPS 322 Pulp and Paper Technology .....	3
WPS 321 Pulp and Paper Technology .....	3	WPS 332 Wood & Pulp/Chemistry .....	4
ST 361 Introduction to Statistics for Engineers I .....	3	Social Science—Humanity Elective .....	3
CH 315 Quantitative Analysis .....	4	Technical Elective .....	3
Free Elective .....	3		18
	18		

#### SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
WPS 471 Pulp/Processes Analysis .....	3	WPS 403 Paper Processes Analysis .....	3
WPS 491 (FOR 491) Senior Problem in Forest Resources .....	1	WPS 463 Plant Inspections .....	1
WPS 413 Paper Properties and Additives .....	3	Free Elective .....	3
Social Science—Humanities Elective .....	6	Social Science—Humanity Elective .....	3
Technical Elective .....	3	Technical Electives .....	6
	16		16
		Total Hours for Graduation .....	132

# PULP AND PAPER SCIENCE AND TECHNOLOGY CURRICULUM

## CHEMICAL ENGINEERING OPTION

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ENG 112H Composition and Reading* . . . . .	3	E 101 Engineering Graphics I . . . . .	2
CH 101 General Chemistry I . . . . .	4	CH 107 Principles of Chemistry . . . . .	4
WPS 101 (FOR 101) Introduction to Forest Resources . . . . .	1	WPS 242 Fiber Analysis . . . . .	3
MA 102 Analytic Geometry & Calculus I . . . . .	4	MA 201 Analytic Geometry & Calculus II . . . . .	4
Social Science-Humanity Elective . . . . .	3	CSC 111 Algorithmic Languages I . . . . .	2
Physical Education . . . . .	1	Physical Education . . . . .	1
	16		16

\*If not qualified, take ENG 111 and 112.

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I . . . . .	4	CH 223 Organic Chemistry II . . . . .	4
PY 205 General Physics . . . . .	4	MA 301 Applied Differential Equations I . . . . .	3
MA 202 Analytic Geometry & Calculus III . . . . .	4	CHE 225 Chemical Process Systems . . . . .	3
CHE 205 Chemical Processes & Principles . . . . .	3	PY 208 General Physics . . . . .	4
Physical Education . . . . .	1	Free Elective . . . . .	3
	16	Physical Education . . . . .	1
			18

### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
WPS 211 Pulp & Paper Internship . . . . .	1	WPS 322 Pulp and Paper Technology . . . . .	3
WPS 321 Pulp & Paper Technology . . . . .	3	CHE 315 Chemical Process Thermodynamics . . . . .	3
CH 431 Physical Chemistry I . . . . .	3	CHE 327 Separation Processes . . . . .	3
CH 432 Physical Chemistry Laboratory . . . . .	1	WPS 332 Wood and Pulping Chemistry . . . . .	4
CHE 311 Transport Processes I . . . . .	3	Social Science-Humanity Elective . . . . .	3
Social Science-Humanity Elective . . . . .	3		16
Free Elective . . . . .	3		
	17		

### SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
WPS 471 Pulping Process Analysis . . . . .	3	WPS 403 Paper Process Analysis . . . . .	3
WPS 411 Pulp/Paper Unit Processes . . . . .	3	WPS 412 Pulp/Paper Unit Processes . . . . .	3
WPS 491 (FOR 491) Senior Problem in Forest Resources . . . . .	1	WPS 463 Plant Inspections . . . . .	1
WPS 413 Paper Properties and Additives . . . . .	3	Technical Elective . . . . .	3
Social Science-Humanity Electives . . . . .	6	Social Science-Humanity Elective . . . . .	3
	16	Free Elective . . . . .	3
			16

Total Hours for Graduation . . . . .131

## WOOD SCIENCE AND TECHNOLOGY

*Professor R. M. CARTER, In Charge*

Wood science and technology is an applied science of an inter-disciplinary nature which brings to bear the various disciplines of the natural sciences, mathematics, engineering and economics in an understanding of wood and its processing. It is a materials science, but also involves industrial manufacturing and management. The wood technologist's job is related to engineering; but, unlike the engineer, his educational exposure to wood science makes him particularly capable in applying his knowledge in such wood processes as machining, seasoning, gluing and finishing.

## CURRICULUM

The purpose of the curriculum is to instruct students in the nature of wood as a natural resource and its processing by means of a systematic study of the properties of wood and the processes involved in its utilization and manufacture.

The curriculum has been designed to provide a high degree of flexibility to enable students to specialize in areas of their interests as they apply to the wood science and technology field. Following a sound coverage in mathematics and the natural sciences, a materials science approach to wood is developed concurrently with training in the processing technology of wood and wood based products and in decision making applied to wood product manufacturing.

At the end of the sophomore year students attend a six-week wood process laboratory practicum in the Brandon P. Hodges Wood Products Laboratory. Following this laboratory students undertake an internship in industry or in institutional research to develop practical experience.

During the final two years of the program students choose a minor, or option, in another discipline outside of the department.

## OPPORTUNITIES

The wood technologist possesses a broad background that includes scientific engineering and industrial knowledge together with specialist depth in the properties and behavior of wood. Today's modern wood manufacturing industries are increasingly seeking new techniques and materials. This rapid development has led to a demand for wood technologists with their combination of skills.

Careers include industrial positions with companies manufacturing lumber, veneer, plywood, particle and fiber boards and consumer wood products such as furniture. Wood technologists are also in demand by suppliers to wood manufacturing industries, such as chemical and machinery companies. Additional policy making opportunities are available with state and federal governments in research, marketing or extension activities.

Wood is a renewable biological resource requiring less energy for processing than other materials. Therefore, the wood technologist will have the opportunity to help improve the environment by developing cleaner processes, working with a renewable resource and creating policies governing environmental development.

## WOOD SCIENCE AND TECHNOLOGY CURRICULUM

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 112 Analytic Geometry & Calculus A* . . . . .	4	MA 212 Analytic Geometry & Calculus B* . . . . .	3
CH 101 General Chemistry I . . . . .	4	CH 103 General Chemistry II . . . . .	4
ENG 111 Composition & Rhetoric . . . . .	3	ENG 112 Composition and Reading . . . . .	3
FOR 101 (WPS 101) Introduction to Forest Resources . . . . .	1	BS 100 General Biology or BO 200 Plant Life . . . . .	4
Social Science—Humanity Elective . . . . .	3	Physical Education . . . . .	1
Physical Education . . . . .	1		15
	16		

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EC 206 The Price System or EC 212 Economics of Agriculture . . . . .	3	Social Science—Humanity Elective . . . . .	3
PY 221 College Physics . . . . .	5	WPS 203 Wood Structure & Properties II . . . . .	3
Social Science—Humanity Elective . . . . .	3	WPS 273 (FOR 273) Quantitative Methods in Forest Resources . . . . .	3
WPS 202 Wood Structure & Properties I . . . . .	3	Option Elective . . . . .	3
Physical Education . . . . .	1	Free Elective . . . . .	3
	15	Physical Education . . . . .	1
			16

## SUMMER PRACTICUM

	<i>Credits</i>
WPS 205 Wood Machining Practicum .....	1
WPS 206 Wood Drying Practicum .....	1
WPS 207 Gluing Practicum .....	1
WPS 208 Wood Finishing Practicum .....	1
WPS 209 Plant Inspections .....	1
WPS 210 Forest Products Internship .....	1

6

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Social Science—Humanity Elective .....	3	Social Science—Humanity Elective .....	3
ST 361 Introduction to Statistics for Engineers I .....	3	WPS 302 Wood Processing II .....	3
WPS 301 Wood Processing I .....	3	WPS 344 Introduction to Quality Control ..	3
WPS 320 Wood Products Chemistry .....	3	WPS 491 (FOR 491) Senior Problems in Forest Resources .....	1
Option Elective .....	3	Option Elective .....	3
	—	Free Elective .....	3
	15		—
			16

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Social Science—Humanity Elective .....	3	WPS 435 (FOR 435) Systems Analysis in Forest Products .....	3
WPS 434 Wood Operations I .....	3	WPS 442 Wood Mechanics & Design .....	3
WPS 441 Introduction to Wood Mechanics .	2	Option Electives .....	6
WPS 492 (FOR 492) Senior Problems in Forest Resources .....	2	Free Elective .....	3
Option Electives .....	5		—
	15		15

Total Hours for Graduation .....129

\* Students with mathematical aptitude and interest are encouraged to substitute MA 102, MA 201 and MA 202 for the mathematical sequence listed.

## FIELDS OF SPECIALIZATION

The program provides the opportunity for students to minor (option) in a discipline outside of the department to the extent of a minimum of 20 credit hours. These options enable the student to develop a second area of concentration of his choice which can be applied to the field of wood science and technology and which can also provide a base for subsequent graduate work in wood science and technology or in the option area selected. Options are available in: a) economics, b) quantitative analysis, c) biology and biochemistry, d) chemistry, e) harvesting operations and f) political science. Options other than those listed may be arranged through the department.

## DUAL DEGREE PROGRAM

A dual degree program has been prepared jointly with the Department of Economics whereby interested students can obtain, in addition to a Bachelor of Science in wood science and technology, a second Bachelor of Science in economics.

This program does require some additional credits beyond those required for the regular single degree program, but capable students can usually complete the necessary additional credits within the four years of the regular undergraduate program.

## HONORS PROGRAM

An honors program is available for students with outstanding records, who may, with the approval of the faculty, substitute a program of advanced studies in lieu of option requirements and certain core courses.



*The Modern Languages laboratory provides an opportunity for students to improve their aural-oral skills.*

# LIBERAL ARTS

R. O. TILMAN, *Dean*  
W. B. TOOLE III, *Associate Dean*

The School of Liberal Arts offers programs of study which lead to the baccalaureate and advanced degrees in the disciplines comprising the humanities and social sciences and also offers courses in these areas which are part of the programs of all undergraduate students in the University.

In making this work available to its students, the University provides an opportunity for its students to prepare for a full life in professions and occupations which require flexibility, broad knowledge and a basic comprehension of human beings and their problems.

Eight departments are included in the School of Liberal Arts: economics (also a department in the School of Agriculture and Life Sciences), English, history, modern languages, philosophy and religion, physical education, politics, and sociology and anthropology (also a department in the School of Agriculture and Life Sciences). Areas of concentration (majors) on the undergraduate level are: economics, accounting, business management, English, history, French, Spanish, philosophy, politics, sociology, speech-communications and multi-disciplinary studies. Degrees granted include the Bachelor of Arts, the Bachelor of Science, the Master of Arts and the Doctor of Philosophy, in addition to professional degrees in economics, politics and sociology. Teacher certification is available in the areas of English, speech-communications, French, Spanish, and social studies (history, economics, politics, sociology).

In all undergraduate programs a minimum average of "C" in the major is required. In the Bachelor of Science program the student must maintain a "C" average both in his major and in his scientific or technical option.

Students transferring from junior colleges are limited to 64 transfer credits plus physical education.

## BACHELOR OF ARTS DEGREE

A sample program of studies satisfying the requirements of the degree of Bachelor of Arts is set out below. Majors are available in economics, accounting, business management, English, history, French, Spanish, philosophy, politics, sociology, speech-communications and multi-disciplinary studies. It should be emphasized that the program is illustrative only; with few exceptions the requirements can be satisfied in a variety of ways. In addition to the general University requirements, the student must present at least two units of a modern foreign language upon entrance.

## BACHELOR OF ARTS SAMPLE PROGRAM

FRESHMAN YEAR			
<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ENG 111 Composition and Rhetoric .....	3	ENG 112 Composition and Reading .....	3
History* .....	3	History* .....	3
Mathematics ** .....	3-4	Mathematics** .....	3-4
Modern Language 201 (Intermediate) .....	3	Modern Language 202 (Intermediate) .....	3
Social Science*** .....	3	Social Science *** .....	3
Physical Education .....	1	Physical Education .....	1
<hr/>		<hr/>	
16-17		16-17	

## SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Literature****	3	Literature****	3
Natural Science*****	3-5	Natural Science*****	3-5
PHI 205 Problems & Types of Philosophy	3	Social Science	3
Social Science	3	Elective	3
Elective	3	Physical Education	1
Physical Education	1		
	16-18		16-18

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Natural Science*****	3-5	Major	9
Major	6	Electives	6
Electives	6		15
	15-17		

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Major	9	Major	6
Electives	6	Electives	9
	15		15

Total Hours for Graduation ..... 124

\* A two-semester program including a course concerned with pre-industrial Western or non-Western societies (HI 204, 207, 208, 209, 215, 216, 263, 264, 265 or 266), and another dealing with the United States or post-industrial Western societies (HI 205, 210, 233, 241, 242, 243, 244 or 272).

\*\* Two semesters for social science majors (MA 111-112 required for economics; MA 111-112 recommended for sociology and politics but MA 115-116 permitted). For all other Liberal Arts majors either two semesters (MA 115-116 or MA 111-112) or one semester plus a course in computer science, statistics, or logic (MA 115 or MA 111 and CSC 200, ST 311, or PHI 201).

\*\*\* Twelve hours in at least two different social sciences, including a two-semester sequence (EC 205-206; PS 200 or 201 plus any other politics course; SOC 202, ANT 252, or PSY 200 plus any other course in the same discipline).

\*\*\*\* A two-semester sequence which surveys English or American literature (ENG 261-262 or ENG 265-266) or the literature of a modern foreign language (MLF 301-302; MLG 301-302; MLS 301-302; MLR 303-304).

\*\*\*\*\* A three-semester program consisting of three courses from three of the following disciplines: physics, chemistry, biology, geology. Or an equivalent program with a two-semester sequence in biology (BS 100 or BS 105 plus another biological science), chemistry (CH 101-103) or physics (PY 211-212) and another course in a natural science other than the one in which the sequence is completed.

## BACHELOR OF SCIENCE DEGREE

The curriculum leading to the degree of Bachelor of Science features a double concentration: one in economics, English, history, philosophy, or politics; and another in a basic science, mathematics or technology. A "C" average must be attained in each. It will be to the advantage of the student to present at least four units of mathematics upon entrance. He must present at least two units of a modern foreign language.

## BACHELOR OF SCIENCE SAMPLE PROGRAM

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	CH 103 General Chemistry II	4
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
MA 111 Algebra and Trigonometry	4	MA 102 Analytic Geometry & Calculus I	4
Modern Language 201 (Intermediate)	3	Modern Language 202 (Intermediate)	3
Physical Education	1	PHI 205 Problems and Types of Philosophy	3
	15	Physical Education	1
			18

## SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>
ENG 205 Reading for Discovery .....	3
History or Social Science .....	3
MA 201 Analytic Geometry and Calculus II ..	4
PY 205 General Physics* .....	4
or	
PY 211 General Physics*	
Physical Education .....	1
	<hr/>
	15

<i>Spring Semester</i>	<i>Credits</i>
History or Social Science .....	3
MA 202 Analytic Geometry and Calculus III ..	4
PY 208 General Physics* .....	4
or	
PY 212 General Physics*	
Elective .....	3
Physical Education .....	1
	<hr/>
	15

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>
BS 100 General Biology .....	4
History of Science*** .....	3
Course I-Humanities or Social Science Concentration .....	3
Course II-Humanities or Social Science Concentration .....	3
Course I-Advanced Technical or Science Option .....	3-4
	<hr/>
	16-17

<i>Spring Semester</i>	<i>Credits</i>
Philosophy of Science*** .....	3
Course III-Humanities or Social Science Concentration .....	3
Course IV-Humanities or Social Science Concentration .....	3
Course II-Advanced Technical or Science Option .....	3-4
Zoology or Botany .....	4
	<hr/>
	16-17

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>
Course V-Social Sciences or Humanities Concentration .....	3
Course III-Advanced Technical or Science Option .....	3-4
Humanities or Social Science Elective .....	3
Elective .....	3
Seminar .....	3
	<hr/>
	15-16

<i>Spring Semester</i>	<i>Credits</i>
Course VI-Social Sciences or Humanities Concentration .....	3
Course IV-Advanced Technical or Science Option .....	3-4
Humanities or Social Science Elective .....	3
Elective .....	6
Seminar .....	3
	<hr/>
	18-19

Total Hours for Graduation .....126-133

\* May be switched with biology if further work in biology is anticipated.

\*\* MA 112, 114 and 212 may be substituted for MA 102, 201, 202.

\*\*\* UNI 301-302; HI 321 or 322 plus PHI 405.

## JOINT LIBERAL ARTS-ENGINEERING PROGRAM

Some students may want to take advantage of the opportunity to combine a Bachelor of Science in engineering with either a Bachelor of Science or Bachelor of Arts in liberal arts. When the two are carried along together the double degree program can be completed in five years. Those interested should contact the Freshman Engineering Division and the Dean of Liberal Arts.

## ECONOMICS

(Also see agriculture and life sciences.)

Patterson Hall

*Professor W. D. TOUSSAINT, Head of the Department*

## TEACHING AND RESEARCH

*Professors:* A. J. BARTLEY, A. J. COUTU, D. M. HOOVER, L. A. IHNNEN, G. D. IRWIN (USDA), H. B. JAMES, P. R. JOHNSON, R. A. KING, G. A. MATHIA, B. M. OLSEN, J. A. SEAGRAVES, R. L. SIMMONS, J. G. SUTHERLAND (USDA), C. B. TURNER, T. D. WALLACE, J. C. WILLIAMSON JR.; *Adjunct Professor:* D. R. DIXON; *Professor Emeriti:* J. G. MADDOX, E. W. SWANSON, T. W. WOOD; *Associate Professors:* D. S. BALL, J. S. CHAPPELL, M. M. EL-KAMMASH, E. W. ERICKSON, R. M. FEARNS,

B. L. GARDNER, C. W. FARRELL JR., E. W. JONES, F. A. MANGUM JR., E. C. PASOUR JR., R. J. PEELER JR., R. K. PERRIN, R. A. SCHRIMPER, R. E. SYLLA, J. W. WILSON; *Assistant Professors*: J. B. BULLOCK, G. A. CARLSON, L. E. DANIELSON, L.M. ENNIS JR., A. R. GALLANT, H. C. GILLIAM JR. (USDA), T. J. GRENNES, D. L. HOLLEY JR., D. N. HYMAN, C. P. JONES, J. C. MATTHEWS JR., R. B. MCBURNEY JR., M. B. MCELROY, L. B. PERKINSON (USDA), W. P. PINNA, J. C. POINDEXTER JR., R. C. REINOSO, H. A. SANDMAN, C. R. SHUMWAY JR.; *Assistant Professor Emeritus*: O. G. THOMPSON; *Instructors*: J. D. ACKER, C. H. BAKER, A. M. BEALS JR., F. V. HARRELL JR., JUDITH M. JEFFERYS, J. S. LAPP, J. H. REEDER, D. H. STUART

## EXTENSION

*Professor F. D. SOBERING, In Charge Extension Economics*

*Professors*: R. C. BROOKS, G. L. CAPEL, D. G. HARWOOD, T. E. NICHOLS, E. A. PROCTOR, C. R. PUGH, W. L. TURNER, C. R. WEATHERS; *Associate Professors*: J. G. ALLGOOD, R. S. BOAL, R. D. DAHLE, L. H. HAMMOND, H. A. HOMME, H. L. LINER, D. F. NEUMAN, P. S. STONE, R. C. WELLS; *Assistant Professors*: J. E. IKERD, E. M. STALLINGS, RUBY P. UZZLE; *Instructor*: D. C. PARDEE

The general objective of the program in economics is to develop in the student such critical and analytical skills as underlie the ability to understand economic problems and institutions, both in their historical setting and under conditions of change. The curriculum furnishes the academic background necessary for positions in industry, government service and graduate work in economics and the social sciences.

The Department of Economics offers programs in several fields of economics at both the undergraduate and graduate levels of study. In addition to the basic economics option, two other options are available to the economics major. The business management and accounting options offer opportunities for professional training in addition to the strong economics background. The accounting option is directed towards fulfilling the educational prerequisites to writing the professional examination for the Certified Public Accountant. The business management option has a combination of business courses that are intended to provide skills for dealing with problems at firm or institutional levels.

The department is administered jointly by the School of Agriculture and Life Sciences and the School of Liberal Arts. For information on the field of agricultural economics, see pages 87-90 under Agriculture and Life Sciences.

The department also has a major service function to perform for the various technical schools and the Division of Continuing Education. An increasing number of curricula now offer a minor program in economics or business.

## FACILITIES

The department has a modern, well-equipped library including technical reference books, major professional journals and government publications. Research publications from other institutions throughout the United States are on file. Graduate students in economics are provided office space and research equipment. Computational facilities are available for students whose research problems involve extensive analysis of data, as well as for those students who want to learn to use computer facilities. The department has a well-trained clerical staff and maintains an IBM 1050 Terminal connected to an IBM System/370 Model 165 operated by the Triangle University Computational Center. Access is also available to other medium speed terminals and an IBM System/360 Model 40 located on the University campus.

BACHELOR OF ARTS DEGREE

BASIC ECONOMICS OPTION

The Bachelor of Arts degree with a major in economics consist of 27 hours in prescribed and elected courses. Of these, 12 hours are required in the core. The remaining 15 hours are restricted electives in economics which are primarily society oriented.

<i>Credits</i>	
EC 301 Production and Prices .....	3
EC 302 National Income and Economic Welfare .....	3
EC 317 Introduction to Methods of Economic Analysis* .....	3
EC 490 Senior Seminar in Economics .....	3
Restricted Electives in Economics .....	15
TOTAL .....	27

ACCOUNTING OPTION

The Bachelor of Arts degree with a major in economics, accounting option, consists of 39 hours in prescribed and elected courses. Of these, 12 hours are required in the core. The remaining 27 hours are divided among six hours of restricted electives in economics and 21 hours in accounting courses.

<i>Credits</i>	
EC 301 Production and Prices .....	3
EC 302 National Income and Economic Welfare .....	3
EC 317 Introduction to Methods of Economic Analysis* .....	3
EC 468 Professional Accountancy Resumé .	3
Restricted Electives in Economics .....	6
Accounting concentration .....	21
TOTAL .....	39

\* ST 311, 361 or 371 may be substituted for EC 317.

BUSINESS MANAGEMENT OPTION

The Bachelor of Arts degree with a major in economics, business management option, consists of 33 hours in prescribed and elected courses. Of these, 18 hours are required as the core. The remaining 15 hours are divided among six hours of restricted electives in economics and nine hours from three of the five areas of business concentration.

<i>Credits</i>	
EC 260 Accounting I—Concepts of Financial Reporting .....	3
EC 301 Production and Prices .....	3
EC 302 National Income and Economic Welfare .....	3
EC 317 Introduction to Methods of Economic Analysis* .....	3
EC 407 Business Law I .....	3
EC 490 Senior Seminar in Economics .....	3
Restricted Electives in Economics .....	6
Electives from Areas of Business Concentration .....	9
TOTAL .....	33

BACHELOR OF SCIENCE DEGREE

The Bachelor of Science degree with a major in economics consists of 27 hours in prescribed and elected courses. Of these, 15 or 18 hours are required as the core. Nine of the remaining hours must consist of restricted electives in economics.

<i>Credits</i>	
EC 205 Economic Activity .....	3
EC 206 The Price System** .....	3
EC 301 Production and Prices .....	3
EC 302 National Income and Economic Welfare .....	3
EC 317 Introduction to Methods of Economic Analysis* .....	3
EC 490 Senior Seminar in Economics .....	3
Restricted Electives in Economics .....	9
TOTAL .....	27

\* ST 311, 361, or 371 may be substituted for EC 317.  
\*\* EC 206 may be waived subject to the approval of the student's faculty adviser.

## ELECTIVE COURSES

Students must complete at least two courses selected from the specified list of restricted economics electives, the two intermediate theory courses (EC 301 and EC 302) and one of the basic statistics courses before enrolling in Senior Seminar (EC 490 or EC 468).

The restricted electives, primarily society oriented, are the following: EC 370, (HI 370), 402, 410, 413, 430, 431, 440, 441, 442, 448, 451, 470 (HI 470), 475, 491, 501, 502, 510, 515, 521, 533, 550, 551, 555, 561, 570 and 574.

Additional firm-oriented economics electives (unrestricted) are available. These courses are often considered business courses and are intended to provide skills for dealing with problems at firm level. The areas of business concentration from which the student taking the business option must select are the following:

Finance: EC 402, 415, 420, 422

Business Management: EC 310, 525, 535

Marketing: EC 311, 411, 430, 521

Personnel: EC 426, 431, 432

Production: EC 303, 425, 523, 551

Courses from other departments may be used to fulfill business concentration requirements upon approval of the Department of Economics.

## GRADUATE STUDY

The Department of Economics offers programs of study leading to the Master of Economics, the Master of Arts in economics, the Master of Science in agricultural economics and the Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.

## ENGLISH

Winston Hall

*Professor* LARRY S. CHAMPION, *Head of the Department*

*Professor* R. B. WHITE JR., *Assistant Head of the Department*

*Professors:* M. HALPEREN, H. G. KINCHELOE, B. G. KOONCE JR., F. H. MOORE JR., G. OWEN JR., C. A. PARKER, W. B. TOOLE III; *Professor Emeritus:* L. HARTLEY; *Associate Professors:* L. J. BETTS JR., P. E. BLANK JR., L. R. CAMP, E. P. DANDRIDGE JR., P. H. DAVIS, J. D. DURANT, J. B. EASLEY, W. G. FRANKLIN, A. S. KNOWLES JR., W. E. MEYERS, N. G. SMITH, T. N. WALTERS, P. WILLIAMS JR.; *Assistant Professors:* BARBARA H. BAINES, J. W. CLARK JR., H. A. HARGRAVE, W. E. HASKIN, M. T. HESTER, C. L. JENKINS JR., R. A. LASSETER III, V. B. LENTZ, CATHERINE E. MOORE, H. E. MUNN JR., M. S. REYNOLDS, NANCY B. RICH, J. M. ROBERTSON, JEAN J. SMOOT, A. F. STEIN, MARILYN M. UPCHURCH, S. S. WARD, H. C. WEST, MARY C. WILLIAMS; *Instructors:* T. L. ATTAWAY, JUDITH H. BOLCH, VIRGINIA C. DOWNS, T. C. HEFFERNAN JR., LINDA T. HOLLEY, C. G. KESHIAN, J. A. KILBY JR., LUCINDA H. MACKETHAN, J. P. MALCOLM, T. H. POSTON, SYBIL R. RICKS, D. D. SHORT, R. V. YOUNG JR., *Special Lecturers:* G. W. BARRAX, AUDREY H. BRADLEY

The Department of English offers both basic and advanced courses in composition, speech, radio, television, language and literature. The freshman courses, common to all curricula and prerequisite to all advanced courses in English, are designed to give intensive training and practice in written communication, plus an introduction to literary types. Courses in communication of technical information, in creative and advanced expository writing, and in speech are offered to meet course requirements in special curricula and to provide electives for interested students. Advanced courses are available for a major in literature, a major in speech-communication in the Bachelor of Arts program, and a concentration in literature and in communications in the Bachelor of Science program, as well as for general electives.

## MAJOR IN ENGLISH

For the English major in the Bachelor of Arts program the student must schedule 30 semester hours beyond the usual six hours in freshman composition. Basic requirements include the sophomore survey of English literature, a course in Shakespeare and at least one course in American writers. Beyond these courses, the student may pursue his special interests within the limits of two recommended categories. In the final semester, a special seminar will serve as a capstone to his study. For a teaching certificate, 18 hours in professional courses and practicum must be included.

For students electing the Bachelor of Science program with English as an area of concentration, eight courses and seminars above the basic freshman and sophomore courses will be selected with the aid of departmental advisers.

## MAJOR IN SPEECH-COMMUNICATION

The major in speech-communication in the Bachelor of Arts program includes 30 semester hours. The curriculum in speech-communication requires four prescribed courses in speech and the usual senior seminar designed to culminate study in the discipline. In addition, the student may elect courses within the field from among offerings in interactive communication, public address, oral interpretation, drama, and radio-television to complete the 30 hour requirement. For a teaching certificate, a more prescribed curriculum is necessary and in addition 18 hours in professional courses and practicum must be included.

## GRADUATE STUDY

In addition to the Bachelor's programs above, the Department of English offers the Master of Arts degree with concentration in English or American literature. The program is designed either to provide the student with a terminal course of study or to serve as the first year toward the doctorate. Prospective applicants should consult the Graduate School Catalog.

## HISTORY

Harrelson Hall

*Professor L. W. SEEGERs, Acting Head of the Department*

*Professor M. S. DOWNS, Assistant Department Head*

*Professors:* B. F. BEERS, M. L. BROWN JR., R. W. GREENLAW, DORIS E. KING, S. NOBLIN; *Adjunct Professor:* H. G. JONES; *Associate Professors:* R. N. ELLIOTT, W. C. HARRIS, J. P. HOBBS, J. M. RIDDLE, S. SUVAL, MARY E. WHEELER; *Associate Professor Emeritus:* L. W. BARNHARDT; *Assistant Professors:* J. R. BANKER, W. H. BEEZLEY, C. H. CARLTON, C. W. HARPER JR., (Education), C. F. KOLB (Continuing Education), JUDITH P. PULLEY, R. H. SACK, EDITH D. SYLLA; *Instructors:* SANDRA P. BABB, ROSEMARY E. BEGEMAN, J. E. CRISP, R. S. DIONNE, H. D. METZGAR JR., J. A. MULHOLLAND, F. M. NICHOLS JR.

An understanding of the historical background of our times is expected of the educated person. The Department of History makes it possible for students to gain this understanding through the wide range and variety of courses at all levels from introductory through graduate.

Any of the department's introductory courses may be counted towards fulfillment of the requirements in the humanities and social sciences of the Schools of Agriculture and Life Sciences, Engineering and Physical and Mathematical Sciences. Students in the School of Liberal Arts are required to take two semesters of history—one dealing with a culture significantly different from their own (examples listed in Group I), and the other dealing with our own or another post-industrial society (examples listed in Group II).

Any 200-level course may be taken without prerequisite and most advanced courses (300-400 level) require only that students have had at least one three hour course in history. Graduate courses, although open to advanced undergraduates, generally have a prerequisite of six hours of advanced level history.

The department cooperates with the Division of Continuing Education in making available certain introductory and graduate courses at night and by correspondence.

## MAJOR IN HISTORY

*Bachelor of Arts Degree Program*—A history major must take 30 hours of course work in history in addition to the six hours required of all students in the School of Liberal Arts. These 30 hours must include the senior seminar, HI 492. At least 18 hours of the 30 must be at the 300 level or above.

## B.A. PROGRAM WITH TEACHER CERTIFICATION

*Bachelor of Arts Program with Teacher Certification*—History majors may enroll in the teacher education program in social sciences offered by the School of Liberal Arts in cooperation with the School of Education. Students who complete this program are eligible for certification to teach social studies in secondary schools in North Carolina. The requirements of the program include professional courses in education in addition to the requirements for the Bachelor of Arts degree, and a major in one of the social studies. Students desiring to enter this program should declare their intention by the spring of the sophomore year and are required to file a formal application for admission which must be approved in order for them to participate.

## CONCENTRATION IN HISTORY

*Bachelor of Science Program*—A concentration in history will involve 18 hours of course work beyond the six hours required of all students in the School of Liberal Arts, plus the senior seminar, HI 492. Of the 18 hours, at least 12 must be at the 300 level or above.

## GRADUATE STUDY IN HISTORY

In addition to the Bachelor's programs, the Department of History offers the Master of Arts degree with a concentration in American or European history or archival administration. The program is designed either to provide the student with a terminal course of study or to serve as the first year toward a doctorate at another institution. Prospective applicants should consult the Graduate School Catalog.

## MODERN LANGUAGES

Harrelson Hall

*Professor* ALAN A. GONZALEZ, *Head of the Department*

*Professors:* G. W. POLAND, E. M. STACK; *Associate Professors:* F. J. ALLRED, MARY PASCHAL, E. W. ROLLINS JR., H. TUCKER JR.; *Assistant Professors:* T. P. FEENY, G. GONZALEZ, W. HOLLER, D. R. KLOE, VIRGINIA PRICHARD, C. R. REYNOLDS, S. E. SIMONSEN, GILBERT SMITH, VIRGINIA SMITH; *Instructors:* N. T. DILL, BRUCE HATHAWAY, W. KOSMIN, NATACHA P. MANN

The Department of Modern Languages provides instruction in French, German, Spanish, Italian and Russian as well as special instruction in English for foreign

students. In addition to elementary grammar, courses are offered in the literature and culture of these language areas. A language laboratory provides further opportunity to students to improve aural-oral skill in a target language.

For a major in French or Spanish in the Bachelor of Arts program 30 hours beyond the six hours of elementary language are required. Aside from this the normal requirement for the Bachelor's degree in Liberal Arts must be met, including either ENG 261-262 or ENG 265-266. Majors desiring a teaching certificate must take required courses in education and psychology.

There are special courses for graduate students preparing to fulfill language requirements for advanced degrees. For graduate students already having a reading knowledge of a foreign language, examinations for certifications are given.

## MULTI-DISCIPLINARY STUDIES

Multi-Disciplinary Studies Committee

*Professor R. S. BRYAN (Philosophy and Religion), Chairman*

*Professor W. B. TOOLE (English)*

*Professor M. S. DOWNS (History)*

*Associate Professor J. W. WILSON (Economics)*

*Assistant Professor L. E. BENNETT (Politics)*

The multi-disciplinary studies program provides the opportunity for a student to design his or her own academic major. Instead of following the requirements for a major in *one* of the traditional disciplines, the candidate for the Bachelor of Arts degree in Multi-Disciplinary studies has the responsibility of organizing a concentration or field of specialization from *two or more* disciplines. A concentration in Latin American studies might, for example, combine related courses in language, literature, history, economics, sociology, and politics.

The freshman and sophomore basic requirements for the multi-disciplinary studies program are the same as for the other Bachelor of Arts programs in Liberal Arts. In satisfying the basic requirements in language, humanities, social science, mathematics and natural science, the student should, whenever possible, choose those courses that are most appropriate as background for the courses in his major concentration.

## ADMISSION TO THE PROGRAM

To become a candidate for a major in multi-disciplinary studies, a student first secures application forms and information from the office of the dean of the School of Liberal Arts (Tompkins Hall, Room 118) or from the office of the chairman of the Multi-Disciplinary Studies Committee (Harrelson Hall, Room 122). He or she then prepares a tentative proposal which includes a list of courses comprising 30 credit hours and an essay of 300-500 words explaining his or her reasons for desiring to make this set of courses the field of specialization. The student's proposal is reviewed by a faculty sponsor and submitted to the Multi-Disciplinary Committee for consideration. After a thorough examination to determine whether the set of courses proposed as a multi-disciplinary major is academically sound and coherent, the committee will recommend that the dean of the School of Liberal Arts accept or reject the proposal; or it will be sent back to the student and his sponsor with suggestions for modification and resubmission.

## PHILOSOPHY AND RELIGION

Harrelson Hall

*Professor R. S. BRYAN, Head of the Department*

*Professor:* P. A. BREDENBERG; *Professor Emeritus:* W. N. HICKS; *Associate Professors:* W. L. HIGHFILL, R. S. METZGER, J. L. MIDDLETON, T. H. REGAN; *Assistant Professors:* W. C. FITZGERALD JR., G. A. LEAR JR., A. D. VANDEVEER; *Instructors:* R. P. FORRER, W. G. GILLMOR, H. D. LEVIN, M. P. O'NEIL, C. L. STALNAKER

The function of the Department of Philosophy and Religion at North Carolina State University is twofold: (1) It serves the needs of the University at large by providing courses devoted to the discussion of the great philosophic ideas of western civilization and of the religious notions which have had an impact on all of civilization, and (2) it provides an opportunity for extensive technical study in philosophy for those students who wish to concentrate in this field either for its own sake or as an ideal intellectual foundation for subsequent graduate or professional study.

Programs leading to two degrees in philosophy, the Bachelor of Arts and the Bachelor of Science, are offered by the department. Candidates for the Bachelor of Arts degree in philosophy must complete 30 hours in philosophy in addition to the introductory course, Problems and Types of Philosophy (PHI 205). These must include either Logic (PHI 201) or Symbolic Logic (PHI 335); courses in the development of western philosophic thought (PHI 300, 317, and 318); and a seminar (PHI 490). Candidates for the Bachelor of Science degree in philosophy must complete 27 hours in philosophy. These must include PHI 300, PHI 317, PHI 318, PHI 335, PHI 490 and PHI 405, Philosophy of Science.

## PHYSICAL EDUCATION

Carmichael Gymnasium

*Professor F. R. DREWS, Head of the Department*

*Professor Emeritus:* P. H. DERR; *Associate Professors:* J. B. EDWARDS JR., A. M. HOCH, H. KEATING, W. R. LEONHARDT, W. H. SONNER; *Assistant Professors:* G. R. BOETTNER, N. E. COOPER, J. M. DANIELS, J. W. ISENHOUR JR., W. P. MARLEY, M. S. RHODES, W. M. SHEA, ELIZABETH A. SMALTZ; *Instructors:* J. W. BARKER, ANDREA L. BERLE, J. V. BROTHERS, W. A. CHEEK, R. C. COMBS, T. W. EVANS, R. G. GWYN, SANDRA L. HILL, VIRGINIA M. LEATH, C. E. PATCH, J. L. SHANNON

North Carolina State University requires from two to four semesters in physical education to be taken consecutively during the freshman and sophomore years. The specific number of semesters of required physical education is determined for each student by the Department of Physical Education based on physical fitness testing and individual interests. Insofar as staff, facilities and allotment of time will permit, each student is guided into courses which will best meet one's individual needs.

## PRESCRIBED COURSES

Prescribed courses are designed to meet the specific needs of the student as determined by tests. The prescribed courses offered are: Health and Physical Fitness, Beginning Swimming I, Beginning Swimming II, Restricted Activity I and Restricted Activity II. The Health and Physical Fitness course is required of all new freshmen. The Department of Physical Education also requires a demonstrated survival swimming ability or placement in the appropriate beginning swimming course.

## CONTROLLED ELECTIVE COURSES

All elective courses are grouped under one of the following areas: aquatics, combatives, developmental activities, individual sports and team sports. Students are encouraged to develop proficiency in at least two vigorous life-time sports.

# POLITICS

Tompkins Hall

*Professor W. J. BLOCK, Head of the Department*

*Professors:* F. V. CAHILL, J. T. CALDWELL, A. HOLTZMAN, R. O. TILMAN; *Associate Professors:* H. G. KEBSCHULL, J. M. MCCLAIN, K. S. PETERSEN; *Assistant Professors:* L. E. BENNETT, T. M. BROWNLEE, W. G. ELLIS, J. H. GILBERT, J. A. HURWITZ, T. E. MARSHALL, J. P. MASTRO, M. S. SOROOS, J. O. WILLIAMS; *Instructors:* HOPE M. BROGDEN, P. M. STEPHENSON, D. A. WENTWORTH

The Department of Politics offers both basic and advanced courses in all major fields of the discipline: American government and politics (local, state and national), comparative government and politics, international relations and organizations, political theory, public administration and methodology of political science. Although the department provides an area in which students may concentrate their major efforts, it also affords opportunities for the study of government and administration to students in other curricula and schools and to students at Fort Bragg. Graduate courses in politics are available to majors and to students seeking advanced degrees in other curricula.

The department conducts a State Legislative Internship Program in alternate years. It also participates in the State Government Internship Program, which functions under the sponsorship of the Institute of Government at Chapel Hill.

## MAJORS IN POLITICS

*Bachelor of Arts Program*—A major in politics requires 30 hours of course work in the discipline, including PS 200, Introduction to Politics; PS 391, Methodology of Political Science; a subsequent seminar in politics; and a course in early or modern political theory. Students are expected to include in their programs advanced courses in at least three of the fields in the discipline, although they may concentrate their work in one field.

The department recommends that its majors, whenever practicable, take MA 111 and MA 112 in fulfillment of the mathematics requirement in the School of Liberal Arts.

## CONCENTRATION IN POLITICS

*Bachelor of Science Program*—A concentration in politics requires 24 hours of course work in the discipline, including PS 200, PS 391 and a subsequent seminar in politics.

*Criminal Justice (either B.A. or B.S.)*—The Departments of Politics and Sociology and Anthropology offer undergraduate majors a concentration in criminal justice. This concentration includes 24 semester hours of specialized study. The objective of the program is to develop students who may move into middle management and policy making positions in agencies such as police, court, correctional, probation and parole agencies.

Students who are interested in the Criminal Justice Program should contact Mr. David Wentworth, 221 Tompkins Hall, Department of Politics, or Dr. Elizabeth Suval, 230 1911 Building, Department of Sociology and Anthropology.

## GRADUATE STUDY

The Department of Politics offers the Master of Arts degree in politics and the Master of Public Affairs degree. Prospective applicants should consult the Graduate School Catalog.

# SOCIOLOGY AND ANTHROPOLOGY

(Also see agriculture and life sciences.)

1911 Building

*Professor S. C. MAYO, Head of the Department*

## TEACHING AND RESEARCH

*Professors:* L. W. DRABICK, C. P. MARSH, G. C. McCANN, J. N. YOUNG; *WNR Professor Emeritus:* C. H. HAMILTON; *Associate Professors:* A. C. DAVIS, C. V. MERCER, H. D. RAWLS, M. M. SAWHNEY, ODELL UZZELL; *Adjunct Associate Professors:* W. J. BUFFALOE, R. L. ROLLINS JR.; *Assistant Professors:* R. C. BRISSON, W. B. CLIFFORD II, C. G. DAWSON, G. L. FAULKNER, T. M. HYMAN, K. D. KIM, R. L. MOXLEY, R. D. MUSTIAN, J. G. PECK, D. J. STEFFENSMEIER, ELIZABETH M. SUVAL, PATRICIA L. TOBIN; *Adjunct Assistant Professor:* J. L. FRANKLIN; *Instructors:* LINDA M. BREYTSRAAK, D. F. COLLINS, S. H. HEIKKINEN, W. B. HUTCHINSON, G. S. NICKERSON, L. J. RHOADES, R. C. WIMBERLEY

## EXTENSION

*Associate Professor J. N. COLLINS, In Charge of Community Development*

*Professor:* J. D. GEORGE; *Professor Emeritus:* J. W. CRAWFORD; *Associate Professor:* T. N. HOBGOOD JR., M. E. VOLAND; *Assistant Professors:* J. A. CHRISTENSON, V. E. HAMILTON, C. E. LEWIS, J. M. STEWART, P. P. THOMPSON

The major aim of this department is to teach students the principles and techniques for understanding human group behavior. More specifically the department seeks: (1) to train students to become leaders in organizing groups and communities and in administering programs; (2) to qualify exceptional students on the undergraduate and graduate levels for sociological research, teaching and extension work; (3) to solve problems in human group relations through scientific research; and (4) to extend research results to the people of the State.

## BACHELOR OF ARTS DEGREE

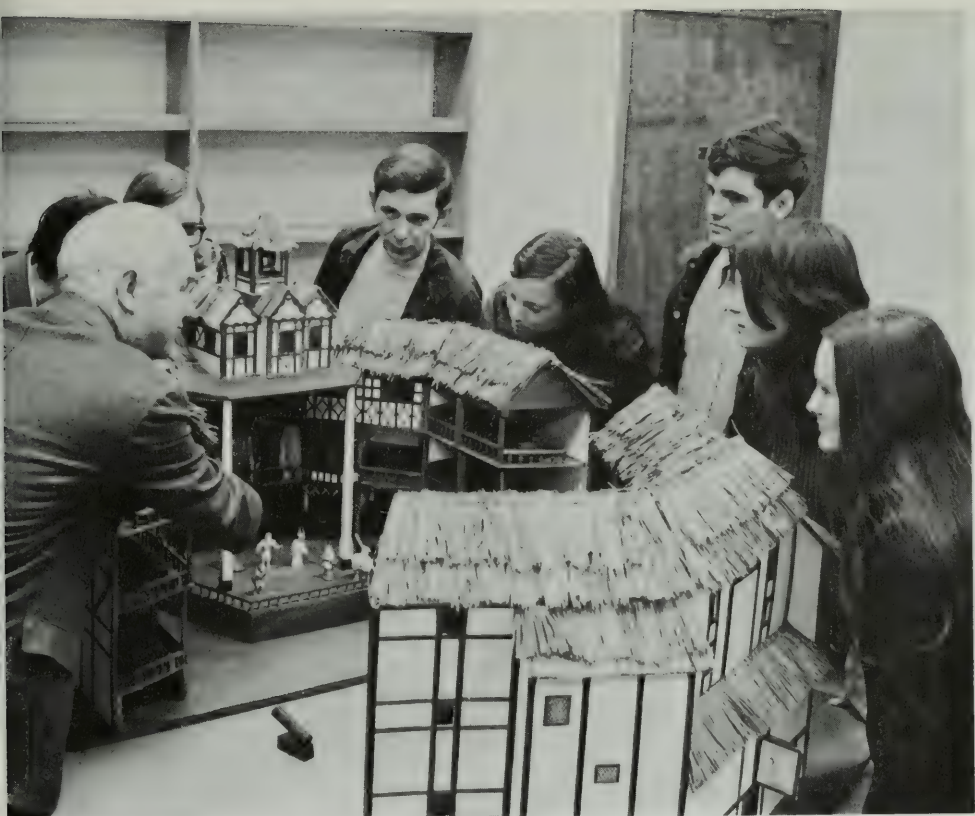
The following departmental requirements must be met by all students majoring in sociology: A minimum of 30 hours in the major field including SOC 202, Principles of Sociology; SOC 301, Human Behavior; SOC 315, Social Thought; SOC 416, Research Methods; a minimum of five electives on the 300 or higher level in sociology; and one semester of SOC 490, Senior Seminar in Sociology. The department also requires ANT 252, Cultural Anthropology, at least one course in psychology and one elective in statistics. In addition, the department offers a concentration of courses in social work. This is to prepare students for employment in human services and to qualify majors for graduate social work education. The concentration includes two semesters of supervised field work.

## GRADUATE STUDY

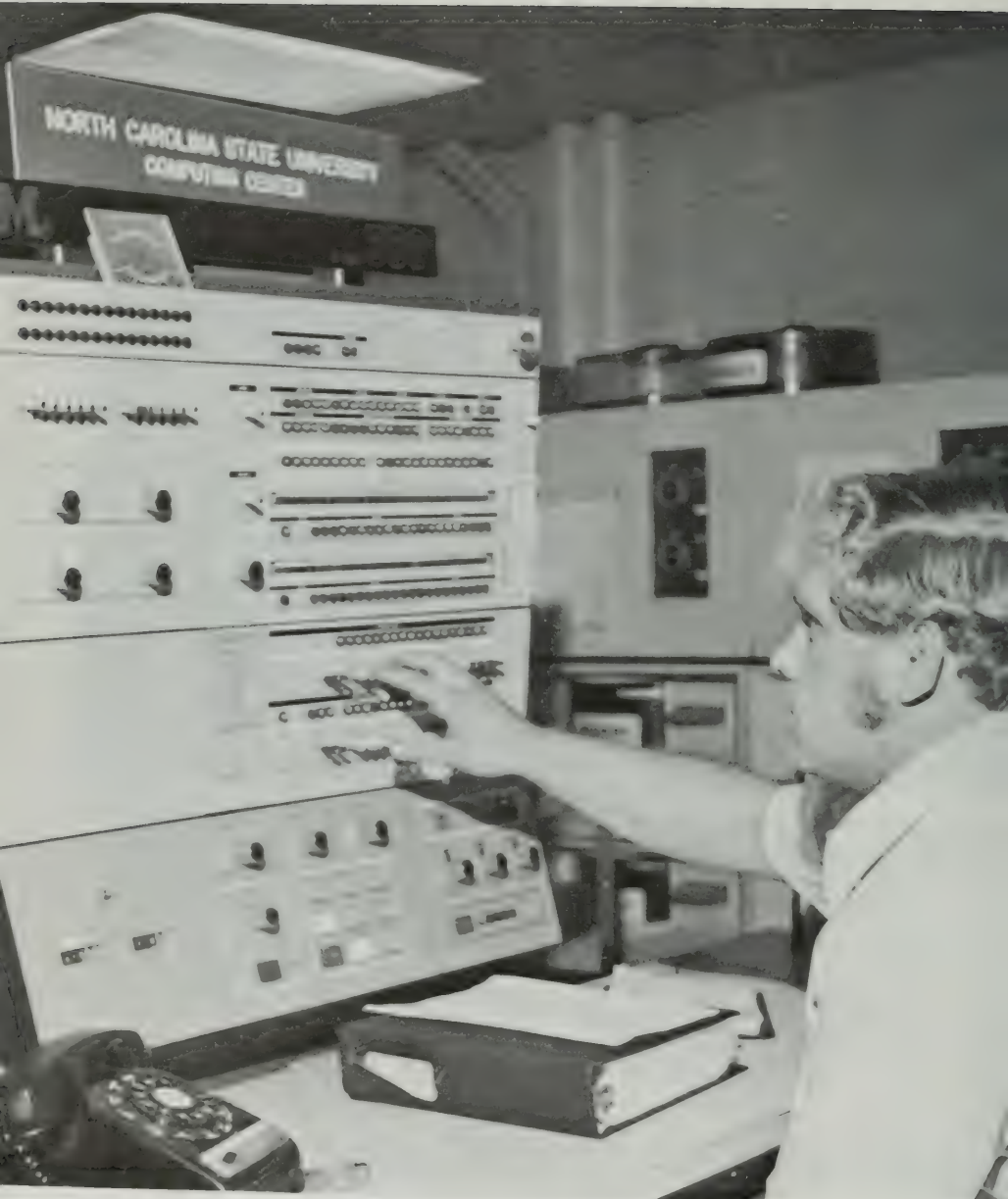
The Master of Science, Master of Sociology and Doctor of Philosophy degrees are offered by this department. Prospective applicants should consult the Graduate School Catalog.

## SPEECH-COMMUNICATION

(See English.)



*Students gain an insight to play production from this Shakespearian Globe theater on permanent display in the D.H. Hill undergraduate library.*



*Today almost all areas of business, industry and education use the computer. In addition to those seeking a degree in computer science, many departments now have their students use the campus facilities as one of the important educational tools.*

# PHYSICAL AND MATHEMATICAL SCIENCES

Cox Hall

ARTHUR CLAYTON MENIUS JR., *Dean*

JASPER DURHAM MEMORY, *Assistant Dean*

The demand for high caliber scientists, mathematicians and engineers continues to outpace the national supply. The need for persons trained in these areas has been a contributing factor in the growth of the School of Physical and Mathematical Sciences since its inception in 1960. The school performs a threefold function: the training of potential scientists and mathematicians; the technical support of curricula in agriculture and life sciences, design, education, engineering, forest resources, liberal arts and textiles; and research in physical sciences and mathematics. These activities are carried out by the seven academic Departments of Biochemistry, Chemistry, Computer Science, Statistics, Geosciences, Mathematics and Physics. The Institute of Statistics (Raleigh section) and the Department of Physical Sciences Research are also associated with the School of Physical and Mathematical Sciences.

Graduates of the school are recruited for technical and administrative positions in industrial research and development laboratories, universities and colleges, nonprofit research organizations and government agencies. A large percentage of the graduates undertake advanced study leading to the Master of Science and Doctor of Philosophy degrees. A lifetime of challenge and opportunity is offered to students who choose these curricula of study.

The high school student with an above-average performance in mathematics, chemistry or physics, and a basic interest in natural phenomena and their mathematical descriptions, is encouraged to consider a career in physical sciences or mathematics. Both ability and motivation are essential prerequisites for successful completion of the bachelor's degree requirements. The school has consistently attracted outstanding students, as evidenced by the fact that approximately one-third of its students graduate with honors or high honors.

## FACILITIES

The offices of the School of Physical and Mathematical Sciences are located in the seven-story Cox Hall, together with the Departments of Physics and Statistics. The adjoining Harrelson Hall, with its 77 classrooms, has as one of its occupants the Department of Mathematics and provides additional classroom space for the school. The new nine-story Dabney Hall, which is adjacent to Cox Hall, houses the Departments of Chemistry and Computer Science. Facilities for geoscience instruction are provided in Withers Hall, a four-story structure near the center of the campus. Physics research laboratories are located in Daniels Hall and the Nuclear Science Building and at the Triangle Universities Nuclear Laboratory in Durham. Biochemistry research is underway in Polk Hall and Withers Hall.

The school is fully equipped for instruction and research. Special equipment and laboratories associated with the school include a plasma physics laboratory supported by a research tube-making facility; a complete radio-chemistry laboratory; a one-million volt Van de Graaff accelerator; analog and ambilog computers; an IBM 1130 digital; a laser research laboratory; a Varian Associates HA-100 high resolution nuclear magnetic resonance spectrometer; an upper atmosphere laboratory; a biomathematics and biophysics laboratory; undergraduate and graduate desk computing laboratories; biochemical research and teaching laboratories; and an ultraviolet-infrared-visible spectroscopic laboratory. Other facilities on the campus available for teaching and research are electron micro-

scopes, a heterogeneous nuclear reactor designed for operation at 100 kilowatts, complete X-ray laboratories with diffraction and radiographic equipment, a Beckman Model E analytical ultracentrifuge, precision instrument shops, and an IBM 360 Model 40 digital computer connected by telecommunication lines to the Model 75 at the Triangle Universities Computation Center. North Carolina State University also participates in the Triangle Universities Nuclear Laboratory which has a 0-35 Mev. cyclo-graaff accelerator.

## **CURRICULA**

The school offers undergraduate programs of study leading to the Bachelor of Science degree with a major in mathematics, chemistry, computer science, statistics, geology or physics. These curricula have similar freshman years, thereby enabling a student to change, without loss of time, from one department to another in the school during the freshman year.

## **SHORT COURSES AND INSTITUTES**

The School of Physical and Mathematical Sciences offers several short courses and specialized institutes throughout the academic year and during the summer months in chemistry, computer science, geology, mathematics, physics, and statistics for high school teachers and college professors. For more information, write to the dean of the school.

In addition, certain regular courses may be taken for credit through correspondence or at the evening college of the Division of Continuing Education in Raleigh, Charlotte or in the Greensboro-Burlington-Winston-Salem area. For a listing of these courses, write to the North Carolina State University Division of Continuing Education, Raleigh.

## **SUPERIOR STUDENT AND HONOR PROGRAMS**

For several years, exceptional students have been selected to participate in the Superior Student Program during their freshman and sophomore years. Enriched courses in mathematics, chemistry, physics and English have been developed specifically for the participants in this program. At the beginning of the junior year, the most promising may select special courses, participate in undergraduate research, and receive some graduate credit toward the Master of Science degree during the senior year.

Well-prepared students entering the school may seek advanced placement in mathematics, chemistry, physics or history by passing qualifying examinations.

## **STUDENT ACTIVITIES**

In addition to University-wide extracurricular activities and honor organizations, the School of Physical and Mathematical Sciences has student chapters of the following professional and honor organizations: Society of Physics Students, Pi Mu Epsilon, the American Chemical Society, and the Association for Computing Machinery.

The Science Council, which is composed of elected students from the school, sponsors and participates in a wide variety of technical and social activities.

## **GRADUATE STUDY**

The Master of Science degree is available with a major in biochemistry, biomathematics, chemistry, geology, marine sciences, statistics, mathematics, applied mathematics and physics. The Master of Applied Mathematics, Master of Biomathematics and Master of Mathematics Education are offered. The Doctor of Philosophy degree is available in biochemistry, biomathematics, chemistry, marine sciences, statistics, mathematics, applied mathematics and physics.

# CHEMISTRY

Dabney Hall and Withers Hall

*Professor Z. Z. HUGUS JR., Head of the Department*

*Professor R. H. LOEPPERT, Assistant Head of the Department*

*Professor F. C. HENTZ JR., Director of General Chemistry*

*Professors:* H. A. BENT, L. H. BOWEN, C. L. BUMGARDNER, G. O. DOAK, L. D. FREEDMAN, F. W. GETZEN, S. G. LEVINE, G. G. LONG, W. J. PETERSON, W. A. REID, P. P. SUTTON, W. P. TUCKER, R. C. WHITE; *Adjunct Professor:* M. E. WALL; *Professors Emeriti:* C. C. ROBINSON, G. H. SATTERFIELD; *Associate Professors:* H. H. CARMICHAEL, A. F. COOTS, M. K. DEARMOND, C. E. GLEIT, L. A. JONES, M. L. MILES, C. G. MORELAND, A. F. SCHREINER, G. H. WAHL JR.; *Associate Professor Emeritus:* W. E. JORDAN; *Assistant Professors:* T. J. BLALOCK, J. BORDNER, T. C. CAVES, K. W. HANCK, W. P. INGRAM JR., S. S. SAWIN, T. M. WARD, D. W. WERTZ; *Instructors:* W. R. JOHNSTON, ELIZABETH H. MANNING, G. M. OLIVER, GRAYE J. SHAW; *Instructor Emeritus:* J. W. MORGAN; *Teaching and Research Technician:* MARGARET C. BUNDY; *Associate Members of the Faculty:* D. M. CATES, H. A. RUTHERFORD (Textile Chemistry)

Chemistry is the science dealing with the composition of all substances and changes in their composition. It is involved with almost every aspect of modern life. Chemists have contributed in large measure to the synthetic fiber industry, petroleum products and fuels, plastics, the food processing industry, nuclear energy, modern drugs and medicine. Today more than ever a chemist is concerned with the fundamental building blocks of all materials—atoms and molecules. This study is leading to a firmer basis for improving old materials, developing new ones and controlling the environment in which we live.

## OPPORTUNITIES

The chemical industry is the nation's largest manufacturing industry. Chemists comprise by far the largest proportion of scientists in the United States, and every indication is that future demands for chemists will continue to grow. A wider variety of jobs is open to the chemist than any other scientist: from biochemistry to metallurgy, from space science to oceanography, from sales or management to pure research. The Bachelor of Science program in chemistry provides an excellent premedical curriculum. Chemists are employed in almost every field based on modern technology. Because of the demand for training in chemistry, opportunities for a chemist in the field of education are many and varied.

## UNDERGRADUATE CURRICULA

### BACHELOR OF SCIENCE IN CHEMISTRY

A chemist's training must be broad. The Bachelor of Science curriculum (as shown below), accredited by the American Chemical Society, includes a strong background of mathematics, physics and the liberal arts. The basic areas of organic, physical, inorganic and analytical chemistry are stressed. Laboratory and classroom work develop the skills, knowledge and inquiring spirit necessary for a successful career in chemistry. The minor field and elective credits allow individual diversity at the junior and senior levels. Many undergraduates participate in current research in the department through part-time employment or a senior research project. The curriculum prepares the student for the wide variety of jobs open to the Bachelor of Science chemist or for advanced work at the graduate level.

### BACHELOR OF SCIENCE, CHEMICAL SCIENCES OPTION

The chemical sciences option provides a more flexible program for students who do not wish to become professional chemists but who wish to pursue interdisciplinary

studies with an emphasis on chemistry. This program has somewhat less stringent requirements in mathematics, physics and chemistry than does the accredited Bachelor of Science program, thus permitting greater latitude in selection of courses from other disciplines. A student who desires this option should enroll initially in the standard Bachelor of Science curriculum. Near the end of the first year, after discussing his goals and proposed program with a departmental advisory committee, he may with their approval, transfer to the chemical sciences option.

## B.S. CHEMISTRY CURRICULUM

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I .....	4	CH 107 Principles of Chemistry .....	4
CH 106 Laboratory Techniques I .....	1	CH 108 Laboratory Techniques II .....	1
ENG 111 Composition and Rhetoric .....	3	ENG 112 Composition and Reading .....	3
MA 102 Analytic Geometry and Calculus I .....	4	MA 201 Analytic Geometry and Calculus II .....	4
Social Science .....	3	PY 201 General Physics* .....	4
Physical Education .....	1	Physical Education .....	1
	16		17

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I .....	4	CH 223 Organic Chemistry II .....	4
English Elective .....	3	English Elective .....	3
MA 202 Analytic Geometry and Calculus III .....	4	MA 301 Applied Differential Equations I .....	3
PY 202 General Physics* .....	4	PY 203 General Physics* .....	4
Physical Education .....	1	Free Electives .....	3
	16	Physical Education .....	1
			18

### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 428 Qualitative Organic Analysis .....	3	CH 401 Systematic Inorganic Chemistry ...	3
CH 431 Physical Chemistry I .....	3	CH 433 Physical Chemistry II .....	3
Humanities—Social Sciences .....	3	CH 434 Physical Chemistry II Laboratory .....	2
MLG 101 Elementary German I .....	3	Humanities—Social Sciences .....	3
Minor** .....	3	MLG 102 Elementary German II .....	3
	15	Minor .....	3
			17

### SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 411 Analytical Chemistry I .....	4	CH 413 Analytical Chemistry II .....	4
Chemistry Elective .....	2	Humanities—Social Sciences .....	3
Humanities—Social Sciences .....	3	Minor .....	3
Minor .....	3	Free Electives .....	6
Free Electives .....	4		16
	16	Total Hours for Graduation .....	131

\*The sequence PY 205, PY 208, PY 407 may be substituted for PY 201, PY 202, PY 203, with approval of the advisor.

\*\*The minor may be in any field closely related to chemistry, such as mathematics, physics, computer science, geoscience, statistics, biological sciences, engineering or science education. A total of four courses in two such areas may constitute a "split" minor. The minor field should be chosen in consultation with the faculty adviser prior to or during the junior year.

# COMPUTER SCIENCE

Dabney Hall

*Professor P. E. LEWIS, Head of the Department*

*Assistant Professor: N. F. WILLIAMSON JR., Administrative Assistant*

*Professor: L. B. MARTIN JR.; Associate Professors: D. A. LINK, Y. N. PATT; Adjunct Associate Professor: L. H. WILLIAMS; Assistant Professors: S. D. DANIELOPOULOS, R. J. FORNARO, J. W. HANSON, T. L. HONEYCUTT, J. D. POWELL, W. E. ROBBINS, W. A. SILLARS, C. W. SKINNER, A. L. THARP; Instructors: H. J. BEAUJON, A. B. FINGER, D. W. REID*

The discipline of computer science has developed during the past 25 years as a direct consequence of the rapid growth of the electronic computer. No single technological development in history has had a greater impact on man and on the way he lives. The uses of modern computers are diverse and new applications continue to arise. They are used to help make and operate our automobiles, airplanes and space ships; to design our highways, bridges and buildings; to handle banking transactions and to assist in management decisions; to analyze farm production; as a research tool for the scientist; to monitor manufacturing processes, utilities and communication; and to provide a multitude of other services. Almost all areas of industry, education and business make use of the computer.

The program of computer science at North Carolina State University is designed to train students to contribute to these applications and, if they choose, to continue their training further through graduate study. Methods and techniques are stressed for using the computer in both scientific and business applications. Students may elect to major in the field working toward the degree of Bachelor of Science in Computer Science. Students in other departments may select as electives certain courses in computer science to broaden their program of study.

In addition to providing a sound background of core courses, the computer science curriculum also provides for more extensive training in several areas or tracks. At the beginning of the junior year, majors in computer science may elect to concentrate study for the last two years of the degree program in one of the following three tracks:

- 1. Scientific Applications
- 2. Management Decisions
- 3. Programming Systems and Languages

Twenty-four credits (called track requirements and restricted electives) may be selected from an approved set of courses appropriate to the track chosen by the student.

There is a need for professionals who are trained in computer science. Salaries are good, and the variety of work is satisfying.

## COMPUTER SCIENCE CURRICULUM

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 101 Introduction to Programming . . . . .	3	CSC 211 Programming Languages . . . . .	3
ENG 111 Composition and Rhetoric . . . . .	3	ENG 112 Composition and Reading . . . . .	3
MA 102 Analytic Geometry and Calculus I . . . . .	4	MA 201 Analytic Geometry and Calculus II . . . . .	4
PMS 100 Orientation . . . . .	0	Basic Science . . . . .	3
Basic Science . . . . .	3	Physical Education . . . . .	1
Physical Education . . . . .	1		
	14		14

## SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 112 Basic Computer Organization and Assembly Language . . . . .	3	CSC 302 Introduction to Numerical Methods . . . . .	3
Humanities—Social Sciences . . . . .	3	Humanities—Social Sciences . . . . .	3
MA 231 Introduction to Linear Algebra . . . . .	3	English Literature Elective . . . . .	3
PY 205 General Physics . . . . .	4	MA 312 Introduction to Differential Equations . . . . .	3
Free Electives . . . . .	3	PY 208 General Physics . . . . .	4
Physical Education . . . . .	1	Physical Education . . . . .	1
	17		17

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 311 Data Structures . . . . .	3	CSC 312 Computer Organization and Logic . . . . .	3
CSC 322 Applied Algebraic Structures . . . . .	3	CSC Track Requirement . . . . .	3
Humanities—Social Sciences . . . . .	3	Humanities—Social Sciences . . . . .	3
ST 371 Introduction to Probability and Statistics . . . . .	4	Restricted Elective . . . . .	3
Restricted Elective . . . . .	3	Free Elective . . . . .	6
	16		18

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 411 Introduction to Simulation . . . . .	3	CSC 412 Introduction to Computability, Language and Automata . . . . .	3
CSC Track Requirement . . . . .	3	Humanities—Social Sciences . . . . .	3
Humanities—Social Sciences . . . . .	3	Restricted Electives . . . . .	6
Restricted Electives . . . . .	6	Free Elective . . . . .	3
	15		15
		Total Hours for Graduation . . . . .	126

## GEOSCIENCES

Withers Hall

*Professor C. J. LEITH, Head of the Department*

*Professors: H. S. BROWN, E. G. DROESSLER, J. LYMAN, W. J. SAUCIER; Professors Emeriti: J. M. PARKER III, J. L. STUCKEY; Associate Professors: N. E. HUANG, W. H. SPENCE, A. H. WEBER, C. W. WELBY; Adjunct Associate Professor: J. R. SMITH; Associate Professor Emeritus: E. L. MILLER JR.; Assistant Professors: M. J. BARTHOLOMEW, R. J. CARSON III, V. V. CAVAROC JR., C. E. KNOWLES, G. F. WATSON JR; Adjunct Assistant Professors: W. D. BACH JR., J. T. PETERSON*

The geosciences include all of the overlapping divisions of the physical, chemical and biological earth sciences, such as geology, geophysics, geochemistry, hydrology, meteorology, oceanography and paleontology. The Department of Geosciences offers courses in each of these related disciplines and awards Bachelor of Arts and Bachelor of Science degrees in geology. The undergraduate program in meteorology is available as an option through the cooperation of other departments in the University. Students in this program are assigned a geosciences adviser in meteorology and an adviser in the cooperating department. Degree programs in oceanography are at the graduate level only.

Geology is the professional field in which geological knowledge and techniques are focused on the solution of problems concerned with the occurrence, origin and distribution of rock and mineral deposits, raw material supplies and with a variety of engineering projects. Many of the larger engineering undertakings such as the construction of dams and reservoirs, tunnels, buildings and highways depend for success in part on an exact knowledge of their geological setting. Discovery,

evaluation, development and conservation of mineral resources (including fossil fuels and ground water) also require the quantitative and analytical application of the findings of geological science regarding the constitution, structure and history of the earth's crust. The geology curriculum combines training in basic physical and engineering sciences with those aspects of geology that are most pertinent to human affairs.

Meteorology is the science of the atmosphere, including the processes and the phenomena within the atmosphere, the interactions with earth's land and sea surface below and with the solar atmosphere above. Its objectives are the understanding of the atmosphere and the complex processes occurring within it and the application of this knowledge to benefit mankind in his welfare and various endeavors. The meteorology courses offered by the Department of Geosciences are designed to provide a basic training for roles in both theory and application and to prepare the student for either research or the varied professional applications.

One of the challenging fields in geoscience is weather modification and control to enhance water supplies, decrease lightning hazards, protect crops from storm damage and perhaps tame the hurricane and the tornado. The atmosphere has a major influence on radio communication, including rocket guidance and control and missile detection and interception. The problem of atmospheric pollution needs thoughtful, searching attention.

In the past few years the physical and geological characteristics of the oceans have become the subject of major research programs in this and in other countries. The Department of Geosciences offers undergraduate and graduate courses in geological, meteorological and physical oceanography.

The theories, instruments and skills needed and developed to study the earth can now be applied to investigating the moon and planets. Conversely, improvements in the instrumentation achieved to further the study of the planets has long been in the domain of astronomy. Now, as instruments reach these other bodies of the solar system, the investigation of them merges into the geosciences.

## **OPPORTUNITIES**

A graduate in geology may follow one of several broad fields either in the United States or in foreign countries: for example, the application of geology to engineering work, or, the application of geology in the mineral industries. Geologists are currently employed by oil companies and quarrying concerns; exploration companies, construction firms; railroads, public utilities, banks and insurance companies; iron, steel and other metal producers; manufacturers using nonmetallic raw materials, such as ceramics, cement and abrasives; municipal, state, and federal government agencies; schools, colleges, museums and research institutes. The southeastern United States offers excellent employment opportunities. There is a growing need for the application of geological science to engineering construction in connection with highways, foundations, excavations, beach erosion control and water supply problems. The mineral industry of the Southeast has expanded substantially in the last decade; known deposits in the region—as yet only partially developed—include iron, nickel, copper, chromite, molybdenite, feldspar, mica, kaolin, kyanite, sillimanite, pyrophyllite, talc, barite, spodumene, sulphur (pyrite), coal, phosphate, granite, limestone and marl.

## **GRADUATE STUDY**

The department offers a graduate program leading to the Master of Science degree in geology and, through its participation in the interdisciplinary marine sciences program, offers work leading to the Master of Science and Doctor of Philosophy degrees in marine sciences with specialization in physical oceanography and meteorological oceanography. Prospective applicants should consult the Graduate School Catalog.

# GEOSCIENCES CURRICULUM LEADING TO B.S. DEGREE IN GEOLOGY

## FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I .....	4	CH 103 General Chemistry II .....	4
ENG 111 Composition & Rhetoric .....	3	or	
Humanities—Social Sciences .....	3	CH 107 Principles of Chemistry	
MA 102 Analytic Geometry & Calculus I .....	4	ENG 112 Composition & Reading .....	3
PMS 100 Orientation .....	0	MA 201 Analytic Geometry & Calculus II .....	4
Physical Education .....	1	PY 205 General Physics .....	4
	—	Physical Education .....	1
	15		—
			16

## SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
GY 120 Physical Geology .....	3	English Literature .....	3
MA 202 Analytic Geometry & Calculus III .....	4	GY 222 Historical Geology .....	3
Modern Language .....	3	GY 330 Crystallography & Mineralogy ...	3
PY 208 General Physics .....	4	MA 301 Applied Differential Equations I* ...	3
Physical Education .....	1	GY 462 Geological Surveying .....	3
	—	Physical Education .....	1
	15		—
			16

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 331 Introductory Physical Chemistry**	4	GY 440 Igneous & Metamorphic Petrology	4
GY 331 Optical Mineralogy & X-Ray Diffraction .....	4	GY 452 Exogenic Materials & Processes ...	4
GY 351 Tectonic Structures .....	3	GY 462 Geological Surveying .....	3
Humanities—Social Sciences .....	3	Humanities—Social Sciences .....	3
Elective .....	3	Minor*** .....	3
	—		—
	17		17

## SUMMER SESSION

GY 465 Geological Field Procedures (or equivalent field camp) .....	6
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## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
GY 323 Paleontology .....	3	Geology Elective .....	3
or		Humanities—Social Sciences .....	3
GY 415 Mineral Exploration & Evaluation		Minor*** .....	3
Humanities—Social Sciences .....	3	Elective .....	3
Minor*** .....	3		—
Electives .....	6		12
	—		12
	15	Total Hours for Graduation .....	129

\* Students electing a minor in statistics may substitute MA 405 for MA 301.

\*\* Students electing a minor in physical sciences (chemistry) will substitute CH 431 for CH 331 and will graduate with a minimum of 128 credit hours.

\*\*\* The minor may be in any field closely related to geology, such as engineering science (engineering mechanics, materials engineering), statistics, physical science (chemistry, physics, meteorology), or biological science (botany, genetics, zoology). The minor field should be chosen in consultation with the faculty adviser prior to or during the junior year.

# GEOSCIENCES CURRICULUM LEADING TO B.A. DEGREE IN GEOLOGY

## FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>
ENG 111 Composition & Rhetoric .....	3
History* .....	3
Humanities—Social Sciences .....	3
MA 111 Algebra and Trigonometry .....	4
Modern Language (Intermediate) .....	3
Physical Education .....	1
	<hr/> 17

<i>Spring Semester</i>	<i>Credits</i>
ENG 112 Composition & Reading .....	3
History* .....	3
Humanities—Social Sciences .....	3
MA 112 Analytic Geometry and Calculus A .....	4
Modern Language (Intermediate) .....	3
Physical Education .....	1
	<hr/> 17

## SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>
CH 101 General Chemistry I .....	4
GY 120 Physical Geology .....	3
Humanities—Social Sciences .....	3
Literature** .....	3
PHI 205 Problems & Types of Philosophy ..	3
Physical Education .....	1
	<hr/> 17

<i>Spring Semester</i>	<i>Credits</i>
CH 103 General Chemistry II .....	4
GY 222 Historical Geology .....	3
GY 330 Crystallography and Mineralogy ...	3
Humanities—Social Sciences .....	3
Literature** .....	3
Physical Education .....	1
	<hr/> 17

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>
GY 331 Optical Mineralogy & X-Ray Diffraction .....	4
HI 422 Rise of Modern Science or .....	
PHI 405 Philosophy of Science .....	3
PY 211 General Physics .....	4
Elective .....	3
	<hr/> 14

<i>Spring Semester</i>	<i>Credits</i>
GY 440 Igneous & Metamorphic Petrology. 4	
GY 452 Exogenic Materials and Processes . 4	
PY 212 General Physics .....	4
Elective .....	3
	<hr/> 15

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>
GY 491 Seminar on Selected Geologic Topics .....	3
GY 351 Tectonic Structures .....	3
Electives .....	6
Geology Option*** .....	3
	<hr/> 15

<i>Spring Semester</i>	<i>Credits</i>
Geology Option*** .....	3
Geology Elective .....	3
Electives .....	6
	<hr/> 12
Total Hours for Graduation .....	124

\* Two semesters of history, one in the study of a culture significantly different from our own (pre-industrial or non-western societies) and the other of our own or similar cultures (the United States or post-industrial western societies, must be taken.

\*\* To be chosen from ENG 261, 262, 265, 266; ML 301, 302. The literature requirement is a six hour sequence in one literary tradition.

\*\*\* GY 323 Paleontology, GY 415 Mineral Exploration and Evaluation, or GY 462 Geological Surveying will satisfy this requirement.

## MATHEMATICS

Harrelson Hall

*Professor N. J. ROSE, Head of the Department*

*Professor H. V. PARK, Associate Head of the Department*

*Professor H. M. NAHIKIAN, Assistant to the Head of the Department*

*Professor L. S. WINTON, In Charge of Undergraduate Advising*

*Associate Professor R. E CHANDLER, Graduate Administration*

*Professors:* J. W. BISHIR, R. C. BULLOCK, E. E. BURNISTON, J. M. A. DANBY W. J. HARRINGTON, K. KOH, J. LEVINE, P. E. LEWIS, J. LUH, P. A. NICKEL, H. SAGAN, H. E. SPEECE, R. A. STRUBLE, H. R. VAN DER VAART, O. WESLER, L. S. WINTON; *Adjunct Professor:* I. N. SNEDDON; *Professors Emeriti:* J. M. CLARKSON, H. A. FISHER, H. P. WILLIAMS; *Associate Professors:* H. C. COOKE, W. G. DOTSON JR., R. O. FULP, J. R. KOLB, C. H. LITTLE JR., J. A. MARLIN, A. R. NOLSTAD, D. M. PETERSON, H. A. PETREA, J. W. QUERRY, G. C. WATSON, J. B. WILSON; *Assistant Professors:* C. N. ANDERSON, S. L. CAMPBELL, T. JOYCE CARAWAY, H. J. CHARLTON, D. E. GAROUTTE, R. GELLAR, D. J. HANSEN, R. E. HARTWIG, RUTH B. HONEYCUTT, J. E. HONEYCUTT JR., C. F. LEWIS, A. MALTBIE, R. H. MARTIN JR., C. D. MEYER JR., L. B. PAGE, C. V. PAO, R. T. RAMSAY, R. G. SAVAGE, R. SILBER, J. L. SOX JR., G. S. SPEIDEL JR., E. L. STITZINGER, D. F. ULLRICH, W. M. WATERS JR.; *Assistant Professors Emeriti:* V. R. BRANTLEY, R. A. MACKERRACHER, P. SHAHDAN; *Instructors:* DOROTHY L. BRANT, H. L. CROUCH JR., H. L. DAVISON, T. F. GORDON, CARLOTTA P. PATTON, H. WRIGHT

Mathematics has long played an important role in the intellectual and technological history of mankind. However, in recent years there has been a dramatic expansion of the knowledge and applications of mathematics. There is consequently a demand for people who are well versed in pure or applied mathematics.

## CURRICULUM

The undergraduate major in mathematics provides a core of basic courses in mathematics together with a program of electives that is sufficiently flexible to prepare a student for graduate study in pure or applied mathematics, for careers in industry, business or government, or for teaching. A carefully selected set of required courses and electives in science, humanities and modern language provide a total program that is well adapted to the demands of modern day life.

Students with a special interest in applied mathematics may take the applied mathematics option.

## REQUIREMENTS FOR BACHELOR OF SCIENCE IN MATHEMATICS

A total of 126 credits distributed as follows:

### *Required Mathematics Courses (29 credits)*

- MA 102-201 Analytic Geometry and Calculus I, II
- MA 231 Introduction to Linear Algebra
- MA 232 Introduction to Multivariable Calculus
- MA 312 Introduction to Differential Equations
- MA 403 Introduction to Modern Algebra
- One semester of probability (MA 214, MA 421, MA 541, ST 421 or ST 371)
- MA 425-426 Mathematical Analysis I, II

### *Science Requirements (17-19 hours)*

- CSC 111 or CSC 101
- PY 205 and PY 208
- CH 101
- CH 103, 105, or 107 or geoscience or life science

### *Required Humanities (15 credits)*

- ENG 111, 112
- Literature—one semester
- Introductory history—one semester
- Modern language at 200 level—one semester

### *Physical Education (4 credits)*

**Technical Electives (21 credits)**

These must include at least nine credits of mathematics at 400-500 level and at least nine credits in technical offerings other than mathematics.

**Humanities and Social Science Electives (18 credits)**

At least six credits must be a junior-senior level

**Free Electives (20-22 credits)**

**APPLIED MATHEMATICS OPTION**

The requirements are the same as above except for the technical electives. For this option the 21 credits of technical electives must include MA 430, Introduction to Applied Mathematics, at least one mathematics elective at the 400-500 level and at least 12 credits in depth from technical offerings other than mathematics.

**SAMPLE PROGRAM IN MATHEMATICS**

(Includes the Applied Mathematics Option.)

**FRESHMAN YEAR**

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 102 Analytic Geometry & Calculus I . . .	4	MA 201 Analytic Geometry & Calculus II . .	4
CH 101 General Chemistry I . . . . .	4	CH 105 Chemistry Principles and	
ENG 111 Composition & Rhetoric . . . . .	3	Applications . . . . .	3
Introductory History . . . . .	3	ENG 112 Composition & Reading . . . . .	3
Physical Education . . . . .	1	Humanities Elective . . . . .	3
	—	CSC 101 Introduction to Programming . . .	3
	15	Physical Education . . . . .	1
			17

**SOPHOMORE YEAR**

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 231 Introduction to Linear Algebra . . .	3	MA 232 Introduction to Multivariable	
PY 205 General Physics . . . . .	4	Calculus . . . . .	3
Literature . . . . .	3	MA 403 Introduction to Modern Algebra . .	3
Modern Language . . . . .	3	PY 208 General Physics . . . . .	4
Humanities Elective . . . . .	3	Free Electives . . . . .	6
Physical Education . . . . .	1	Physical Education . . . . .	1
	—		17
	17		

**JUNIOR YEAR**

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 425 Mathematical Analysis I . . . . .	3	MA 426 Mathematical Analysis II . . . . .	3
MA 312 Introduction to Differential		Probability . . . . .	3
Equations . . . . .	3	Humanities Elective . . . . .	3
Humanities Elective . . . . .	3	Technical Electives . . . . .	6
Technical Elective . . . . .	3		15
Free Electives . . . . .	3		
	—		
	15		

**SENIOR YEAR**

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Technical Electives* . . . . .	9	Technical Electives . . . . .	9
Humanities Elective . . . . .	3	Humanities Elective . . . . .	3
Free Elective . . . . .	3	Free Elective . . . . .	3
	—		—
	15		15

\* One of these must be MA 430 for the applied mathematics option

**GRADUATE STUDY**

Graduate programs are offered at both the masters and doctoral levels. The core of basic courses in algebra, modern analysis and applied mathematics are required of all students. The remaining program is quite flexible. The large variety

of course offerings in the department in conjunction with the many other scientific and engineering departments allow for any desired degree of emphasis in either pure or applied mathematics.

## PHYSICS

*Professor L. W. SEAGONDOLLAR, Head of the Department*

*Professor J. T. LYNN, Graduate Administrator and Assistant to the Head of the Department*

*Professors:* W. H. BENNETT, J. M. A. DANBY, W. R. DAVIS, W. O. DOGGETT, G. L. HALL, A. W. JENKINS JR., H. C. KELLY, E. R. MANRING, J. D. MEMORY, A. C. MENIUS JR., R. L. MURRAY, D. L. RIDGEWAY, D. R. TILLEY, A. W. WALTNER; *Professors Emeriti:* F. W. LANCASTER, J. S. MEARES; *Associate Professors:* G. C. COBB JR., G. H. KATZIN, D. H. MARTIN, G. E. MITCHELL, M. K. MOSS, J. Y. PARK, R. R. PATTY; *Assistant Professors:* K. T. CHUNG, R. E. FORNES, C. R. GOULD, F. LADO JR., G. W. PARKER III, J. F. SCHETZINA; *Assistant Professor Emeritus:* E. J. BROWN; *Instructor:* H. L. OWEN; *Instructor Emeritus:* MINNIE W. C. HARRIS

Physics is a fundamental science of observations, measurements and the mathematical description of the particles and processes of nature. In addition to extending our basic knowledge of the universe, the science of physics provides the means for attacking problems of importance in modern technology. The variety of the contributions made by physicists is indicated by activities such as the discovery of new particles of nature, the invention and use of new instruments to probe interplanetary space, the study of processes fundamental to the release of thermonuclear energy, the development of lasers and solid state devices, and research on missiles, satellites and space craft.

## PROGRAMS

The Physics Department provides at both the graduate and undergraduate levels programs of study in fundamental physics and in several areas of specialization, including relativity theory, nuclear physics, plasma physics, infrared spectroscopy, magnetic resonance, atmospheric physics, solid state physics and lasers.

## UNDERGRADUATE STUDY

The undergraduate curriculum in physics provides the basic training for a career in physics or for graduate study

## PHYSICS CURRICULUM

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
PMS 100 Orientation .....	0	PY 201 General Physics .....	4
CH 101 General Chemistry I .....	4	MA 201 Analytic Geometry & Calculus II ..	4
ENG 111 Composition & Rhetoric .....	3	CH 107 Principles of Chemistry .....	4
MA 102 Analytic Geometry & Calculus I ..	4	ENG 112 Composition & Reading .....	3
Humanities—Social Sciences .....	3	Physical Education .....	1
Physical Education .....	1		16
	15		

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
English Elective .....	3	Humanities—Social Sciences .....	3
Humanities—Social Sciences .....	3	MA 301 Applied Differential Equations I ..	3
MA 202 Analytic Geometry & Calculus III ..	4	Modern Language .....	3
Modern Language .....	3	PY 203 General Physics .....	4
PY 202 General Physics .....	4	PY 413 Thermal Physics .....	3
Physical Education .....	1	Physical Education .....	1
	18		17

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 512 Advanced Calculus II .....	3	Humanities—Social Sciences .....	3
PY 411 Mechanics I .....	3	Mathematics Elective .....	3
PY 414 Electricity & Magnetism I .....	3	PY 412 Mechanics II .....	3
PY 451 Intermediate Experiments in Physics I .....	2	PY 415 Electricity & Magnetism II .....	3
Free Elective .....	3	PY 452 Intermediate Experiments in Physics II .....	2
	—	Free Elective .....	3
	14		17

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanities—Social Sciences .....	3	Humanities—Social Sciences .....	3
Mathematics Elective .....	3	PY 402 Modern & Quantum Physics II ....	3
PY 401 Modern & Quantum Physics I ....	3	PY 409 Ion & Electron Physics .....	3
PY 416 Physical Optics .....	3	PY 410 Nuclear Physics I .....	4
Free Elective .....	3	Free Elective .....	3
	—		—
	15		16
		Total Hours for Graduation .....	128

## GRADUATE STUDY

The Department of Physics offers the Master of Science and Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.

## STATISTICS

Cox Hall

*Professor D. D. MASON, Head of the Department*

*Professor R. G. D. STEEL, Graduate Administrator*

*Professor F. E. MCVAY, Undergraduate Administrator*

*Professors:* C. C. COCKERHAM, A. H. E. GRANDAGE, R. J. HADER, D. W. HAYNE, H. L. LUCAS JR., R. J. MONROE, L. A. NELSON, C. H. PROCTOR, C. P. QUESENBERRY, J. O. RAWLINGS, D. L. RIDGEWAY, J. A. RIGNEY, H. R. VAN DER VAART, T. D. WALLACE, O. WESLER; *Adjunct Professors:* A. L. FINKNER, D. G. HORVITZ, J. T. WAKELEY; *Professor Emeritus:* GERTRUDE M. COX; *Associate Professors:* B. B. BHATTACHARYYA, F. G. GIESBRECHT, H. J. GOLD, M. M. GOODMAN, W. L. HAFLEY, A. R. MANSON, B. F. SWINDEL (USFS), J. L. WASIK; *Assistant Professors:* A. R. GALLANT, T. M. GERIG, A. C. LINNERUD, MARY B. WILLIAMS; *Adjunct Assistant Professors:* D. L. BAYLESS, H. T. SCHREUDER; *Instructor:* JOLAYNE W. SERVICE; *Senior Research Technologist:* F. J. VERLINDEN; *Research Associate Technologist:* A. J. BARR; *Research Assistant Technologist:* J. L. CHRISTOPHER; *Research Associates:* A. ANGELONE, J. GRAHAM; *Associate Statisticians:* H. K. HAMANN, B. J. STINES; *Assistant Statisticians:* P. H. GEISSLER, J. H. GOODNIGHT, H. J. KIRK, D. W. TURNER, F. T. WANG

Statistics is the body of scientific methodology which deals with the logic of experiment and survey design, the efficient collection and presentation of quantitative information and the formulation of valid and reliable inferences from sample data.

The Department of Statistics in Raleigh is part of the Institute of Statistics which includes a Department of Biostatistics and a Department of Statistics at Chapel Hill. The Department of Statistics provides instruction, consultation and computational services on research projects for other departments of all schools at North Carolina State University including the Agricultural Experiment Station; the department staff are also engaged in an extensive program of research in statistical theory and methodology. This wide range of activities furnishes

professional environment for training students in the use of statistical procedures in such fields as the physical, biological and social sciences, and in industrial research and development.

OPPORTUNITIES

The graduate in statistics will find abundant employment opportunities that will be intellectually and financially rewarding. The importance of sound statistical thinking in the design and analysis of quantitative studies is generally recognized. Industry relies on statistical methods to control the quality of goods in the process of manufacture and to determine the acceptability of goods produced. Statistical procedures based on scientific sampling have become basic tools in such diverse fields as weather forecasting, opinion polling, crop and livestock estimation and business trend prediction. Because he can improve the efficiency of use of increasingly complex and expensive experimental and survey data, the statistician will continue to be in demand wherever quantitative studies are conducted.

TYPICAL STATISTICS CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ENG 111 Composition and Rhetoric .....	3	ENG 112 Composition and Reading .....	3
CH 101 General Chemistry I .....	4	CH 103 General Chemistry II .....	4
MA 102 Analytic Geometry and Calculus I ..	4	MA 201 Analytic Geometry and Calculus II. .	4
CSC 101 Introduction to Programming ..	3	BS 100 General Biology .....	4
Physical Education .....	1	Physical Education .....	1
PMS 100 Orientation .....	0		
	15		16

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ST 371 Introduction to Probability and Statistics .....	4	PSY 200 Introduction to Psychology .....	3
MA 231 Introduction to Linear Algebra ...	3	MA 232 Introduction to Multivariable Calculus .....	3
PY 205 General Physics .....	4	PY 208 General Physics .....	4
EC 205 Economic Activity .....	3	EC 206 The Price System .....	3
Physical Education .....	1	Major Elective .....	3
	15	Physical Education .....	1
			17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ST 421 Introduction to Mathematical Statistics .....	3	ST 422 Introduction to Mathematical Statistics .....	3
Major Elective .....	3	Major Elective .....	3
Modern Language .....	3	Modern Language .....	3
Humanities Elective .....	3	Humanities Elective .....	3
Biological Science Elective .....	3	Free Elective .....	3
Free Elective .....	3		
	18		15

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ST 501 Basic Statistical Analysis .....	3	ST 502 Basic Statistical Analysis .....	3
Major Elective .....	3	Major Elective .....	3
ENG 321 The Communication of Technical Information .....	3	SP 231 Expository Speaking .....	3
Humanities Elective .....	3	Humanities Elective .....	3
Free Elective .....	3	Free Elective .....	3
	15		15
		Total Credits for Graduation .....	126

## GRADUATE STUDY

The Department of Statistics offers work leading to the Master of Science, Master of Statistics (non-thesis) and Doctor of Philosophy degrees. The department also offers degrees in biomathematics: Master of Science, Master of Biomathematics (a non-thesis degree) and Doctor of Philosophy in Biomathematics. Prospective applicants should consult the Graduate School Catalog.



# TEXTILES

Nelson Textile Building

DAVID W. CHANEY, *Dean*

W. E. SMITH, *Assistant to the Dean for Student Services*

M. L. ROBINSON JR., *Academic Coordinator*

Textiles is broader than the name implies. It covers almost every aspect of our daily lives—with applications in medicine, in space, in recreation and sports, in personal safety, in environmental improvement and control, in transportation and in household and apparel uses. These versatile materials—textiles—are made to exacting design specifications by a wide variety of modern high-speed processes, utilizing various tools such as lasers, electronics and computers. Textiles begins with the synthesis of fibers by man or by nature; it carries through a myriad selection of processes for fabric formation, including the steps necessary to make fabrics useful, such as the manufacture of dyestuffs and coloring, chemical auxiliaries and finishes, cutting and fashioning into end-use products.

The approximately 4,500 graduates of the School of Textiles enjoy enviable positions in North Carolina, where the majority of them now live. They hold important occupations in the textile and related industries, ranging from manufacturing management, sales, corporate management, designing and styling, research development and technical service to quality control and personnel management. In these positions textile graduates are involved in the creative and management decision-making aspects of the industry. They plan the flow of materials and machines. They create new products and processes. They solve product and process problems. They create styles, designs, patterns, colors, textures, and structures for apparel, home and industrial uses. They engineer the systems and products required of industrial, space, medical, apparel and other uses of textile products. They deal with computers, automation, product quality, plant performance and environmental problems. They manage large and small companies, personnel, and systems. Most important they are leading citizens contributing not only to the individual company, but to the development and well-being of the communities in which they live.

The School of Textiles prepares young men and women for careers in any of the above occupations. A broad background is stressed, with as much as two-thirds of the educational program coming from the broad resources of the University outside the school. Opportunities today remain excellent, with the School maintaining one of the best placement records in the University. Demand for textile graduates from North Carolina State University is particularly strong, due in part to the strength of the academic programs offered. These programs are organized in two departments: textile technology and textile chemistry.

## CURRICULA

The School of Textiles offers a broad curricula choice depending upon the interests of the individual student. Terminal Bachelor of Science programs in textile technology or in textile chemistry permit the broadest choice of courses in addition to the core courses that are required. For example, a student may specialize in yarn or fabric structures, in textile economics and marketing or fabric styling and design. The student's curriculum will include choices in the

humanities, social sciences and basic sciences and, according to the emphasis he chooses, may result in a minor in economics, industrial engineering, languages, mathematics, physics, political science, statistics or textile chemistry (or technology). The structure of the minor sequence of courses may be such that a student can proceed to graduate study in either the minor field or in textile chemistry or technology. Alternatively it is possible, with only one summer of extra work, to obtain a double degree, for example in textile technology and textile chemistry.

Curricula leading to graduate study, particularly to Doctor of Philosophy programs such as that offered by the School of Textiles in fiber and polymer science, differ from those of terminal Bachelor of Science programs primarily in the junior and senior year. While considerable latitude is still possible, there are a number of prescribed courses that must be taken. The nature of these will depend upon the type of graduate study anticipated.

Textile chemistry is designed to give the student fundamental education in chemistry with special emphasis on the application of this science to textiles. The textile chemistry curriculum places emphasis on chemical fundamentals so that those students who complete the program with a high degree of excellence are adequately prepared for graduate study either in pure or applied chemistry. Similarly, students who complete the program in any of the minors in textile technology with a high degree of excellence would be acceptable for graduate study in numerous areas.

Inasmuch as the professional work in textiles is concentrated to a great extent in the last two years of the student's program, it is possible for students from either junior or community colleges or other institutions of higher learning to transfer to the School of Textiles with a minimum loss of time.

## **INSPECTION TRIPS**

For certain of the textile courses offered, it is desirable for the student to see the manufacturing process under actual operating conditions. When possible trips are arranged for student groups to visit outstanding manufacturing plants. Participation in the trips is required; transportation costs and other travel expenses, while held to a minimum insofar as possible, must be paid by the student.

## **SUMMER EMPLOYMENT**

Job opportunities for summer employment are available for textile students. Placement assistance is available through the school placement office and frequently can be arranged in the student's home community. Qualified students may arrange to receive academic credit of up to three hours for faculty-approved summer jobs. Usually this will be for one summer period only, and usually at the end of the junior year.

## **DEGREES**

Upon completion of programs in either textile technology or textile chemistry, the degree of Bachelor of Science is conferred.

The School of Textiles offers the following degrees: Bachelor of Science in textile technology or textile chemistry; Master of Textile Technology; Master of Science in textile technology or textile chemistry; and Doctor of Philosophy in fiber and polymer science. For general requirements for graduate degrees, consult the Graduate School Catalog.

By mutual agreement between the faculties involved, candidates for the Doctor of Philosophy degree in other schools of this institution may specialize in essentially textile-related subjects. In such cases, it is often logical for the research involved to be done in the School of Textiles.

## THE FOUR-ONE PROGRAM

The School of Textiles has developed a program designed to permit the student with a baccalaureate degree from an accredited college or university to complete the requirements for a Bachelor of Science degree in textile technology or textile chemistry after the satisfactory completion of one year of study.

Students entering this program should have completed mathematics, physics and chemistry comparable to that required in the basic textile technology or textile chemistry curriculum. Presuming these conditions are met, the student can complete the degree requirements in two regular semesters and summer school. Students not meeting the minimum requirements in the sciences or applied mathematics could remove deficiencies in the summer session prior to the fall semester, allowing completion of studies at the end of the normal period or in the following summer sessions.

The undergraduate program of each applicant is considered individually and, in general, a complete transfer of credits is possible.

## FACILITIES

The Nelson Textile Building, erected in 1939 and greatly enlarged in 1950, was designed to coordinate teaching and laboratory facilities. It houses one of the most modern and best-equipped textile institutions in the world. The Department of Textile Chemistry is housed in the Clark Laboratories, located south of the Nelson Textile Building.

## OPPORTUNITIES

Technological advances in textile fibers and manufacturing techniques have created a tremendous demand for persons educated in textile colleges. For the past several years, the School of Textiles has had a demand for more graduates than it could supply. Its graduates have entered the textile industry at salaries equal to or better than those offered in any other industry.

Graduates of the school are equipped to enter the many expanding activities of the textile field, and alumni of the school hold responsible positions in the general areas of manufacturing, marketing, research and administration. Many are now plant managers, presidents and other top-level executives.

To assist in the placement of students and alumni and to facilitate interviews by textile firms, the school maintains a fulltime director of student affairs and placement.

## TEXTILE CHEMISTRY

David Clark Laboratories

*Professor H. A. RUTHERFORD, Head of the Department*

*Assistant Professor R. MCGREGOR, Graduate Administrator*

*Professors: K. S. CAMPBELL, D. M. CATES, R. D. GILBERT, G. GOLDFINGER, R. W. WORK; Adjunct Professors: A. E. DAVIS JR., H. F. MARK, A. M. SOOKNE; Associate Professors: J. A. CUCULO, T. H. GUION, W. K. WALSH; Assistant Professors: C. D. LIVENGOD, M. H. THEIL; Associate Professor Emeritus: A. C. HAYES; Adjunct Assistant Professors: K. K. GHOSH, L. A. GRAHAM, W. R. MARTIN JR., Research Associate: C. E. BRYAN*

The field of textile chemistry embraces a number of disciplines and is concerned, in part, with those industrial processes that constitute the final steps in the preparation of textile materials for the consumer. Common terms applied to these processes are scouring, bleaching, printing, dyeing and finishing. Textile chemistry is also concerned with fiber-forming polymers, both natural and man-made, and how the chemical and physical properties of such materials vary

with fiber structure. The purpose of the department is to provide students with a fundamental knowledge of the underlying principles that relate to this derivative field and a perspective that includes the many interacting factors involved in the preparation and conversion of polymeric materials to useful products.

## CURRICULA

The department has two curricula, referred to below as Programs "A" and "B". "A" is specifically designed for those students who wish to take an advanced degree in fiber and polymer science. "B" is oriented toward a terminal Bachelor of Science degree. However, pursual of "B" by the undergraduate does not mitigate against the student entering a graduate program; by proper choice of electives beginning in the junior year a student may terminate program "B" with essentially the same background as one who takes "A" from the start.

The essential difference between the two is that "A" requires more mathematics, chemistry and textile chemistry than "B". The course sequences required are described in footnotes after each program.

Although not indicated specifically in the curricula outlines which follow, the student may choose a minor in a number of different disciplines. Choice of course material is flexible and is made in consultation with the student's adviser. Moreover, through the proper choice of electives a student may in a four-year period complete the requirements for two degrees: textile chemistry and textile technology; textile chemistry and chemistry; and textile chemistry and mathematics. Other combinations are possible, but may require a fifth year of study.

## FACILITIES

Located in the David Clark Laboratories are departmental offices, classrooms, laboratories and pilot facilities for instruction and research. The departmental radiation laboratory is located in the Nelson Building. Radiation facilities include a Cobalt 60 source and a 500 KV Electron Accelerator.

Equipment is available for ultra-violet, visible, infrared, nmr and esr spectroscopy, reflectometry, colorimetry, viscometry, chromatography, differential thermal analysis, thermal gravimetric analysis, differential scanning calorimetry, instrumental measurement of color and computer color matching. Common testing equipment used for the evaluation of the physical properties of textile materials and for determining the color-fastness, wash-fastness, etc., of fibers and fabrics is also available. Complete pilot plant facilities are available for demonstration of all wet-processing operations used in the field of textiles.

## UNDERGRADUATE CURRICULUM IN TEXTILE CHEMISTRY

### PROGRAM A

#### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
T 101H Fundamentals of Textiles .....	2	TC 203 Fiber Science I .....	3
ENG 111 Composition & Rhetoric .....	3	ENG 112 Composition and Reading .....	3
CH 101 General Chemistry I .....	4	CH 107 Principles of Chemistry .....	4
MA 102 Analytic Geometry & Calculus I .....	4	MA 201 Analytic Geometry & Calculus II .....	4
Physical Education .....	1	Physical Education .....	1
	<hr/> 14		<hr/> 15

## SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
TC 303 Textile Chemistry I .....	2	TC 304 Textile Chemistry II .....	2
CH 221 Organic Chemistry I .....	4	T 305 Introduction to Color Science .....	1
MA 202 Analytic Geometry & Calculus III .....	4	CH 223 Organic Chemistry II .....	4
TX 220 Yarn Forming Systems .....	4	PY 205 General Physics .....	4
(or TX 250)		MA 301 Applied Differential Equations I .....	3
Free Elective .....	3	Humanities or Social Science Elective .....	3
Physical Education (if required) .....	1	Physical Education (if required) .....	1
	18		18

## JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
TC 461 Chemistry of Fibers .....	3	TC 412 Textile Chemical Analysis II .....	3
CH 315 Quantitative Analysis .....	4	ST 361 or CSC 101 (or CSC 111) .....	2 or 3
PY 208 General Physics .....	4	CH 431 Physical Chemistry I .....	3
TX 250 Fabric Forming Systems .....	4	Humanities or Social Science Elective .....	6
(or TX 220)			14-15
Humanities or Social Science Elective .....	3		
	18		

## SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
TC 403 Textile Chemical Technology .....	3	TC 404 Textile Chemical Technology .....	3
TC 405 Textile Chemical Technology Laboratory .....	2	TC 406 Textile Chemical Technology Laboratory .....	2
Textile Chemistry Elective** .....	3 or 4	TC 491 Seminar in Textile Chemistry .....	1
CH 433 Physical Chemistry II .....	3	TC Elective** .....	3 or 4
Humanities or Social Science Elective .....	3	Humanities or Social Science Elective .....	3
Free Elective .....	3	Free Elective .....	3
	17		15 or 16
		Total Hours for Graduation .....	130

\*\*TC 561 Organic Chemistry of High Polymers

\*\*TC 562 (CH 562) Physical Chemistry of High Polymers—Bulk Properties

\*\*TC 505 Theory of Dyeing

\*\*T-492 Problems in Science and Technology

\*\*TC 401 The Textile Industry and the Environment

\*\*T 506 Color Science

# UNDERGRADUATE CURRICULUM IN TEXTILE CHEMISTRY PROGRAM B

## FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
T 101H Fundamentals of Textiles .....	2	TC 203 Fiber Science I .....	3
ENG 111 Composition & Reading .....	3	ENG 112 Composition & Reading .....	3
CH 101 General Chemistry I .....	4	CH 107 Principles of Chemistry .....	4
MA 102 Analytic Geometry & Calculus I* .....	4	MA 201 Analytic Geometry & Calculus II .....	4
or		or	
MA 112 Analytic Geometry & Calculus A .....	4	MA 212 Analytic Geometry & Calculus B .....	3
Physical Education .....	1	Physical Education .....	1
	14		14 or 15

# SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
TC 303 Textile Chemistry I .....	2	TC 304 Textile Chemistry II .....	2
CH 221 Organic Chemistry I .....	4	T 305 Introduction to Color Science .....	1
MA 202 Analytic Geometry & Calculus III .....	4	CH 223 Organic Chemistry II .....	4
or		PY 205 General Physics** .....	4
MA 114 Topics in Modern Mathematics .....	3	PY 211 General Physics .....	4
TX 220 Yarn Forming Systems .....	4	Humanity or Social Science Elective .....	3
(or TX 250)		Physical Education (if required) .....	1
Free Elective .....	3		
Physical Education (if required) .....	1		
	16-18		

# JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
TC 461 (CH 461) Chemistry of Fibers ....	3	TC 412 Textile Chemistry Analysis II ....	3
CH 315 Quantitative Analysis .....	4	ST 361 or CSC 101 (or CSC 111) ....	2 or 3
PY 208 General Physics .....	4	Elective from Schedule A .....	4
or		Humanity or Social Science Elective .....	6
PY 212 General Physics .....	4		
TX 220 Fabric Forming Systems .....	4		15-16
(or TX 220)			
Humanity or Social Science Elective .....	3		
	18		

# SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
TC 403 Textile Chemical Technology .....	3	TC 404 Textile Chemical Technology .....	3
TC 405 Textile Chemistry Technology Laboratory .....	2	TC 406 Textile Chemistry Technology Laboratory .....	2
Textile Chemistry Elective*** .....	3 or 4	TC 491 Seminar in Textile Chemistry .....	1
Elective from Schedule A .....	3	Textile Chemistry Elective*** .....	6
Humanity or Social Science Elective .....	3	Humanity or Social Science Elective .....	3
Free Elective .....	3	Free Elective .....	3
	17-18		18
		Hours for Graduation .....	129

\*One of the following mathematics sequences is required: MA 114, MA 112, and MA 212 or MA 102, MA 201, and MA 202.

\*\*One of the following physics sequences is required: PY 211 and PY 212, or PY 205 and PY 208

\*\*\*Textile chemistry electives include:

\*\*\*TC 561 Organic Chemistry of Polymers

\*\*\*TC 562 (CH 562) Physical Chemistry of Polymers—Bulk Properties

\*\*\*TC 505 Theory of Dyeing

\*\*\*T-492 Problems in Science and Technology

\*\*\*TC 401 The Textile Industry and the Environment

\*\*\*T 506 Color Science

## Program B Sequences

Schedule A comprises a two-course sequence totaling six semester hours. The sequence selected by the student must meet the approval of his adviser. One of the following sequences must be elected:

TX 431 Special Topics in Testing .....	3	PY 411 Mechanics I .....	3
TX 530 Textile Quality Control .....	3	PY 412 Mechanics II .....	3
	6		6
CH 431 Physical Chemistry I .....	3	MA 511 Advanced Calculus I .....	3
CH 433 Physical Chemistry II .....	3	MA 512 Advanced Calculus II .....	3
	6		6

CH 331	Introductory Physical Chemistry ..	4
	and choice of:	
MA 301	Applied Differential Equations I ..	3
CH 441	Colloid Chemistry .....	3
CHE 569	Polymers, Surfactants & Colloidal Materials .....	3
		<hr/> 7

## GRADUATE STUDY

The Department of Textile Chemistry offers a master's degree in textile chemistry. Prospective applicants should consult the Graduate School Catalog.

## TEXTILE TECHNOLOGY

Nelson Textile Building

*Professor J. F. BOGDAN, Head of the Department*

*Professors:* D. S. HAMBY, S. P. HERSH, J. A. PORTER JR.; *Professors Emeriti:* E. B. GROVER, J. T. HILTON, W. E. SHINN; *Associate Professors:* E. H. BRADFORD, A. H. EL-SHIEKH, T. W. GEORGE, J. W. KLIBBE, P. R. LORD, W. K. LYNCH, W. E. MOSER, J. E. PARDUE, T. G. ROCHOW, W. C. STUCKEY JR.; *Adjunct Associate Professor:* V. F. HOLLAND; *Associate Professor Emeritus:* J. G. LEWIS; *Assistant Professors:* P. BROWN, W. D. COOPER, R. E. FARNES, B. S. GUPTA, E. E. HUTCHISON, FRANCES W. MASSEY, H. M. MIDDLETON JR., D. M. POWELL, M. L. ROBINSON JR.; *Adjunct Assistant Professor:* D. H. BLACK; *Assistant Professor Emeritus:* A. J. WOODBURY; *Research Instructor:* P. L. GRADY; *Instructor:* P. A. TUCKER JR.

The purpose of the Textile Technology Department is to instruct students in the theory and fundamental concepts of fiber properties and fiber processing into yarns and fabrics. This is accomplished through the systematic study of the basic properties of both the materials being processed and of the process involved. The department is engaged in research, with the support coming from University funds and from industrial and governmental sponsors. Not only faculty, but graduate and undergraduate students are encouraged to participate in the research program.

## CURRICULUM

The curriculum, during the student's first two years, is concerned primarily with the physical sciences, humanities and social sciences, with limited but important basic studies in textile fundamentals. Following this phase of work, the student in his junior and senior year does his or her major work in textiles.

The primary objective of the textile technology curriculum is to provide as general an education as possible and at the same time to prepare the graduate for a profitable and rewarding career in the textile industry. This is accomplished through an integration of the physical and social sciences and the application of these sciences and economics to the field of textiles.

In addition to the wide selection of sciences, the student also has the opportunity for diversification within the School of Textiles. The curriculum offers depth in such selected areas as fiber and yarn technology, fabric technology, knitting technology, general textiles and textile management.

## OPTIONS

For a student to develop a second field of interest, the Department of Textile Technology offers, in addition to the major field of study, an opportunity for the selection of an option from a discipline outside the department. The student may, however, select to do most of his work in textile technology.

These options add two facets to the student's possible growth. Not only can strength be developed in a second discipline, but upon completion of the under-

graduate work, one may pursue a graduate program of study in textiles or in the discipline selected as the option.

Selection of the option can, in most cases, be delayed until the first semester of the junior year. This permits the student time to determine which field holds the greatest interest. This timing is also appropriate for the transfer student from both the North Carolina State University campus and from other schools such as the community colleges since most or all of the work in the other school can be applied to the requirements of the first two years of study in the department. If the transfer student has completed two full years at another institution, the amount of prerequisite work is minimized, since the majority of the major and minor studies are concentrated in the junior and senior years.

## FACILITIES

The facilities of the Department of Textile Technology are subdivided into laboratory areas for processing of short staple fibers, long staple synthetic fibers, throwing and texturizing continuous filament yarns. Too, laboratories for the study of the formation of woven, knitted and nonwoven fabrics including tufting and yarn preparation systems are available. The knitting laboratories include a hosiery section, circular and double knitting, warp and flat knitting, and knit goods finishing. The department has extensive facilities for physical testing of fibers, yarns and fabrics. A textile physics laboratory includes equipment designed for specialized problems related to textiles.

## TEXTILE TECHNOLOGY CURRICULUM

### FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I .....	4	CH 103 General Chemistry II .....	4
ENG 111 Composition & Rhetoric .....	3	or	
Humanity-Social Science Elective .....	3	CH 107 Principles of Chemistry	
MA 111 Algebra & Trigonometry* .....	4	ENG 112 Composition & Reading .....	3
T 101 Fundamentals of Textiles .....	2	MA 112 Analytic Geometry &	
Physical Education .....	1	Calculus A .....	4
	—	TX 220 Yarn Forming Systems .....	4
	17	Physical Education .....	1
			16

### SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 111 Algorithmic Languages I** .....	2	Humanity-Social Science Elective .....	3
Humanity-Social Science Elective .....	3	PY 211 General Physics .....	4
MA 212 Analytic Geometry &		TX 211 Fiber Science II .....	3
Calculus B .....	3	TX 320 Design & Control of	
TC 203 Fiber Science I .....	3	Staple Yarn Systems .....	5
TX 250 Fabric Forming Systems .....	4	Physical Education .....	1
Physical Education .....	1		—
	—		16
	16		

### JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
PY 212 General Physics .....	4	TX 350 Woven Fabric Structures .....	5
ST 316H Introduction to Statistics		TX 380 Management & Control of	
for Engineers I .....	3	Textile Systems .....	3
TC 301 Technology of Dyeing &		TX 460 Physical Properties of	
Finishing .....	4	Textile Fibers	
TX 340 Principles of Knitted		or	
Fabric Structures .....	5	TX 560 Structural & Physical	
	—	Properties of Fibers .....	3
	16	Option Hours	
		(Programs A, B, C) .....	3
		Free Elective .....	3
			17

# SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanity-Social Science Elective .....	3	Humanity-Social Science Elective .....	6
TX 330 Textile Measurement & Quality Control .....	4	Option Hours (Programs A, B, C) .....	6
Option Hours (Programs A, B, C) .....	6	Free Elective .....	4
Free Elective .....	3		16
	16	Total Hours for Graduation .....	130

\*MA 114 may, under certain circumstances, be substituted for MA 111. For students qualifying the mathematics sequence shall be MA 102, Analytic Geometry and Calculus I, MA 201, Analytic Geometry and Calculus II, MA 202, Analytic Geometry and Calculus III.

\*\*Optional.

Eighteen credit hours of humanity-social science electives are required. These 18 hours are to include three credit hours of English and EC 206. When practical, students are encouraged to take a minimum of two courses in the areas chosen to fulfill the humanity-social science requirement. The choice of course sequence and scheduling will be planned by the faculty adviser and the student.

## PROGRAM A

Program A is designed for the student interested in pursuing advanced studies in the basic and applied sciences. The textile courses in the option emphasize the physics and mechanics of textile structures and materials. The program is ideally suited for, but not limited to, those interested in pursuing graduate studies in the Master of Science or Doctor of Philosophy programs. The actual sequence of courses constituting the 15 hours in the option would be selected based upon the interest of the student with the approval of the faculty adviser. Typical courses from which the option may be structured are: MA 301, MA 511, EM 301, PY 411, PY 412, PY 413, T 500, TC 461, TX 465, TX 561. The student would be expected to select at least six hours of 400 or 500 level textile courses.

## PROGRAM B

Program B, consisting of 15 hours, is based upon a background in basic economics and is designed to develop an understanding of management control systems, decision-making theories and marketing and distribution systems. Six hours of course work must be selected from EC 260, EC 420, EC 407, EC 426, EC 431, EC 432. Required courses in the option are TX 480, TX 482 and TX 484.

## PROGRAM C

Program C provides an opportunity for students to elect advanced courses of study in the field of textiles. These courses may be selected from the elective offerings by the department and may be used to develop in depth study in knitting, yarn forming systems, fabric forming systems, quality control or combinations of these areas.

For those students interested in developing a sequence of courses in a discipline outside the Department of Textile Technology, these 15 hours may be used in whole or in part for courses in computer science, mathematics, physics, industrial engineering, textile chemistry and statistics. The sequence of courses comprising the program of study will be planned by the student and faculty adviser.

Those textile technology students interested in a sequence of courses in textile chemistry are encouraged to develop a program that will lead to a dual degree in textile technology and textile chemistry.

# TYPICAL PROGRAM OF STUDY FOR THE FOUR-ONE BACHELOR OF SCIENCE CURRICULUM IN TEXTILE CHEMISTRY AND TEXTILE TECHNOLOGY

## TEXTILE CHEMISTRY

## TEXTILE TECHNOLOGY

### SUMMER SESSIONS

#### First Session

<i>Credits</i>				<i>Credits</i>	
TC 203	Fiber Science I	3	TC 203	Fiber Science I	3
TX 220	Yarn Forming Systems	4	TX 220	Yarn Forming Systems	4
		7			7

#### Second Session

<i>Credits</i>				<i>Credits</i>	
TX 250	Fabric Forming Systems	4	TX 211	Fiber Science II	3
		4	TX 250	Fabric Forming Systems	4
					7

### FALL SEMESTER

<i>Credits</i>				<i>Credits</i>	
TC 403	Textile Chemistry Technology	3	ST 361	Introduction to Statistics	
TC 405	Textile Chemistry		for Engineers I	3	
	Technology Laboratory	2	TX 320	Design & Control of	
TC 461 (CH 461)	Chemistry of Fibers	3	Staple Yarn Systems	5	
Textile Chemistry Elective*		3	TX 340	Principles of Knitted	
ST 361	Introduction to Statistics		Fabric Structures	5	
for Engineers I		3	TX 350	Woven Fabric Structures	5
or					18
CSC 101	Introduction to Programming	3			
or					
CSC 111	Algorithmic Languages	2			
		13 or 14			

### SPRING SEMESTER

<i>Credits</i>				<i>Credits</i>	
CH 331	Introductory Physical		TC 301	Technology of Dyeing &	
Chemistry		4	Finishing	4	
TC 404	Textile Chemistry Technology	3	TX 330	Textile Measurement &	
TC 406	Textile Chemistry		Quality Control	4	
	Technology Laboratory	2	TX 380	Management & Control of	
TC 412	Textile Chemistry Analysis II	3	Textile Systems	3	
TC 491	Seminar in Textile Chemistry	1	TX 460	Physical Properties of	
Textile Chemistry Elective*		3	Textile Fibers	3	
		16			14

\*May be chosen from T 506, Color Science; TC 401, The Textile Industry and the Environment; TC 504, Fiber Formation—Theory and Practice; TC 505, Theory of Dyeing; TC 561, Organic Chemistry of High Polymers; TC 562 (CH 562), Physical Chemistry of High Polymers—Bulk Properties; TC 569 (CHE 569), Polymers, Surfactants and Colloidal Materials.

Students completing this program may continue to the graduate level if scholastic average is suitable.

## GRADUATE STUDY

The Department of Textile Technology offers the Master of Science and the Master of Textile Technology degrees. Prospective applicants should consult the Graduate School Catalog.

## TEXTILE RESEARCH

MORTON R. SHAW, *Assistant Dean for Research*

An examination of the nature of the research conducted in the School of Textiles during the last decade reveals a pattern of change as the needs of the educational program and the textile industry itself have changed. Emphasis has swung between basic and applied research as well as between chemical and technology orientation. Interdisciplinary research conducted on a team basis has become of importance as problems have become more complex and the techniques of conducting joint research are learned. Such type of research provides the learning experiences for those students who will be entering industry where team research predominates. Such research covers a wide gamut of problems having to do with textiles, fibers, and polymers.

## TEXTILES EXTENSION AND CONTINUING EDUCATION PROGRAM

D. S. HAMBY, *Director*

WILLIAM H. HARD, *Assistant to the Director*

The extension and continuing education program of the School of Textiles is designed to serve the needs of the textile industry by disseminating research findings and offering short courses for executive and scientific personnel in the industry.

The extension phase of the program is intended to provide a closer liaison with the textile industry. It currently has several objectives. One is to offer courses off campus for academic credit. Such courses are given when and where there is a sufficient demand. Another objective is to administer programs in which textile students are involved off campus, for example summer jobs, in industry for which credit is given. A third objective is to transmit new research findings and other valuable information to the textile industry.

The continuing education activities of the school range from seminars to two-week short courses. They range in scope from the highly scientific to the more practical level. A number of these courses are offered on a regular schedule while others are arranged as the need arises.

## MACHINE DESIGN AND DEVELOPMENT

PAUL D. EMERSON, *Head*

C. M. ASBILL JR., *Professor Emeritus*

Engineering assistance to faculty and students of the School of Textiles is provided by Machine Design and Development. This function includes textile engineering aspects of fiber production and processing, textiles manufacturing and testing, and mechanical and electronic instrumentation, as well as textile machinery design and development.

Complete facilities are available for design, construction and evaluation of experimental or developmental textile equipment.

Assistance to industry is provided in the form of consultation on matters relating to textile engineering, particularly in the field of noise measurement and control. The department also endeavors to remain current with recent engineering advances applicable to textiles and maintains active liaison with industry and the scientific community.

## OFFICE OF STUDENT SERVICES

WILLIAM E. SMITH, *Director*

The Office of Student Services is responsible for the placement and financial aid programs of the School of Textiles. The placement function makes available to a potential employer the credentials of our students for permanent and summer employment and in a great number of cases performs equally for alumni.

The financial aid function operates by committee and makes it possible for any North Carolina student to pursue an education in textiles through scholarships, loans or grants as long as he or she maintains the academic and moral standards of the University.

The office is also responsible for representing the School of Textiles to the high schools in North Carolina through participating in the North Carolina Guidance and Personnel Association.

The director of the Office of Student Services is a member of the Executive Committee of the School of Textiles and is, to a great extent, the liaison between the student body and the student government with the administration of the school.

In general, it is the bridge between the academic and the extracurricular activities for the students.

## BURLINGTON TEXTILES LIBRARY

J. G. BAKER, *Librarian*

The School of Textiles library was originally organized in 1944 as a branch of the D. H. Hill Library. In 1951, as a result of a substantial gift by Burlington Mills Foundation, the library was relocated in the west wing of the Nelson Building, and in 1965 the library was expanded, doubling the original space. This expansion was again made possible through Burlington Industries, Inc.

Attractive furnishings and air-conditioning create an area conducive to study and research. The library has individual study carrels, a reading lounge, a reference/bibliography area and a seminar room. More shelving and storage have been provided for an ever-growing collection of textile books, journals, trade catalogs, patents and pamphlets. Typing facilities for students and photocopy services for users of the collection are available.

The library subscribes to various commercial indexing/abstracting services including *Chemical Abstracts*, *Textile Technology Digest* and *World Textile Abstracts*.

The library lends to students, faculty and research staff of the institution, and will also lend to textile industry personnel. Interlibrary loan services are available to other institutions. "Literature searching" within reasonable limits is performed for qualified persons.

# UNIVERSITY STUDIES

Harrelson Hall

*Professor* ALBERT CARNESALE, *Head*

*Professor:* JOHN R. LAMBERT JR.; *Associate Professor:* J. C. WALLACE; *Assistant Professor:* R. M. CORNISH; *Instructors:* R. L. HOFFMAN, C. L. STALNAKER

University Studies is an academic unit offering courses that are problem- or issue-oriented and that are taught in an interdisciplinary format. Courses are open without course prerequisites to students in all curricula. In addition to a permanent teaching staff, faculty is drawn from the academic disciplines directly concerned with the problems or issues under consideration.

## GRADUATE SCHOOL

WALTER J. PETERSON, *Dean*

Graduate instruction at North Carolina State University is organized to provide opportunity and facilities for advanced study and research in the fields of agriculture and life sciences, architecture, design, engineering, forestry, certain disciplines in the School of Liberal Arts, physical and mathematical sciences, technological education and textiles. The purpose of these graduate programs is to develop in advanced students a more adequate comprehension of the requirements and responsibilities essential for independent research investigation. In all the graduate programs emphasis is placed upon a high level of scholarship rather than upon the satisfaction of specific course or credit requirements.

Exceptional facilities for graduate study are provided at North Carolina State University. New buildings furnish modern well-equipped laboratories for graduate study in many areas.

For a list of graduate degrees offered at North Carolina State University, see pages 13-14.

## DIVISION OF CONTINUING EDUCATION

1911 Building

WILLIAM LINDSAY TURNER, *Vice Chancellor for Extension and Public Service*

DAVID B. STANSEL, *Associate Director*

*Assistant Directors:* C. F. KOLB, M. E. STARNES; *Assistant to the Director:* H. H. ETHRIDGE; *Graphics Manager:* H. G. WALKER JR.; *Continuing Education Specialists:* N. B. BROYLES, K. R. CRUMP, J. F. CUDD JR., J. B. GORDON, D. S. JACKSON, M. E. SHIELDS; *Director of Instruction, Truck Driver Training School:* R. M. HAYNIE JR.; *Social Services Specialists:* ANN T. LICHTNER; *Aging Specialist:* SANDS GRESHAM

The Division of Continuing Education of North Carolina State University is the statewide adult education service linking the University, its scholars, research and resources with the people and communities of the State. Varying in length and format from one-day conferences and short courses to regular semester-length

classes and educational television, continuing education's philosophy and objectives rest upon five premises:

1. To assist professional persons, scientists, and engineers to stay abreast of the knowledge explosion in their particular fields;
2. To make available to each individual the opportunity to continue his or her higher educational advancement—either graduate or undergraduate;
3. To make available to each citizen the cultural advantages of the University so that each can broaden his horizons and make adjustments to our civilization; and
4. To create an awareness and an understanding among citizens of the public issues and public affairs so that they are better able to make objective decisions.
5. To meet the educational needs of all the people who are not already served by other state institutions in ways consonant with the high academic standards of North Carolina State University.

Though increasingly designed for those who have been to college, many programs are open to any adult who can benefit from university-level study. The instructional staff consists of faculty from the University, from other institutions, and outstanding authorities in specific fields.

Only those programs appropriate to the standards of scholarship and instruction of North Carolina State University are offered as continuing education programs. Both credit and noncredit programs are offered on the University campus, in communities throughout the State and by correspondence instruction throughout the world.

## **CORRESPONDENCE COURSES**

The division offers more than 46 different courses through its Bureau of Correspondence Instruction. Credit courses are offered in the following subject areas: agriculture, economics, education, engineering, English, geosciences, history, mathematics, modern languages, philosophy, politics, sociology and statistics. The correspondence bureau also has available high school review courses in English and mathematics. These courses can be utilized by persons who need to fulfill certain college entrance requirements, or by persons who have either scored poorly or need additional help on college entrance examinations.

## **CREDIT AND NONCREDIT EVENING CLASSES**

The division offers, during the fall and spring semesters, a series of credit and noncredit courses on the University campus. The credit courses are sponsored and taught by the academic departments of the University and are generally conducted in the late afternoon and evening. These courses are offered to the already occupied mature person who is unable to attend classes during daytime hours. Approximately 110 courses in a variety of subject areas are offered each semester. The noncredit classes are designed for cultural and professional enrichment.

## **OFF-CAMPUS CREDIT CLASSES**

Extension classes are offered in all sections of the State. These offerings are mainly on a need basis or by request from organizations or special groups. Courses are available in almost all subject matter areas from engineering to the social sciences. During the previous year the division administered 70 credit classes in 22 different locations with registrations totaling over 1,210.

## **SHORT COURSES, INSTITUTES, AND CONFERENCES**

Variety and the necessity for providing educational opportunities for all the people of the State are the keystone to the division's offerings of short courses,

institutes, conferences, etc. These programs, more than any others, mark the University's efforts to meet its land-grant tradition of providing education to all the people. The scope of the programs include: agriculture, engineering, forestry, textiles, the physical sciences, economics, management, communications, education and recreation. During the year 1971-72, there were 170 courses offered with registrations totaling over 10,283.

The North Carolina Truck Driver Training School (classified as a short course program) annually offers 12 four-week courses for professional truck drivers. The school is sponsored by the North Carolina Motor Carriers Association.

## EDUCATIONAL TELEVISION

Television Center

JACK PORTER, *Director*

The North Carolina State University Television Center is an integral unit of University of North Carolina educational television, a statewide television system capable of reaching approximately 90 percent of the state's population through a network of interconnected broadcast transmitters. The Center produces a wide variety of instructional, informational and general programs for public use through this system. In addition, it is involved in creating and coordinating television materials for on-campus instructional programs at North Carolina State University.

## SUMMER SESSIONS

1911 Building

CHARLES F. KOLB, *Associate Director*

The Summer Sessions at North Carolina State University offers an extensive education program designed to meet the varied needs and interests of thousands of students who come to the campus each summer.

Each of the University's eight schools—represented by more than 50 different departments—offers instruction in over 400 courses, more than 40 percent of which are at the graduate level. A faculty of more than 350 teachers participates in programs for summer study. Six of the eight schools offer regular courses during the two five-week terms. The School of Design offers one nine-week program and the School of Forestry conducts a summer camp for sophomores and two five-week practicums. In addition, there are numerous special programs and institutes offered during the summer by the University.

Summer courses and special programs are designed for the new student, the undergraduate wanting to advance his academic standing at North Carolina State University, the graduate desiring to continue his study and research during the summer months, and the visiting student pursuing degrees at other institutions. The summer program can also be utilized by persons in professional fields who simply wish to keep abreast of new developments and trends in their particular area of endeavor. There is also the opportunity to take required subcollege level work in English and mathematics for those seeking to enroll at the University.

Students seeking information regarding any of the University's summer activities should contact: Director of Summer Sessions, North Carolina State University, Post Office Box 5125, Raleigh, North Carolina 27607.

## URBAN AFFAIRS AND COMMUNITY SERVICES CENTER

1911 Building

*Associate Director:* W. G. ROBERTS JR.

*Assistant Directors: SPURGEON CAMERON, F. E. EMORY*

The center is the focal point for a campus-wide research, education and community service program which is designed to enable North Carolina State University to respond more effectively to the problems of our urbanizing society. The program encourages multidisciplinary participation by faculty and students with a high priority being given to the service-learning concept. Through the auspices of the center, representatives from federal, state and local governmental units, as well as private agencies, can join with University personnel in working on problems of mutual concern. Program areas now receiving attention include housing, human resources development, volunteerism, child development, urban renewal, social services, environmental quality and regionalism. The center program is closely coordinated with the work being done at other campuses of the University as well as that of other educational institutions.

## COMPUTING CENTER

LEROY B. MARTIN JR., *Director*

North Carolina State University is one of the three universities owning the Triangle Universities Computation Center (TUCC). This internationally known facility is located in the Research Triangle Park 15 miles from Raleigh. The other participating universities are the University of North Carolina at Chapel Hill and Duke University at Durham.

The central equipment located at TUCC is an IBM System 370, Model 165 with 2.0 million characters of memory. In addition, 900 million characters of on-line storage are available as well as extensive teleprocessing equipment for communication with the member universities and other institutions throughout the state.

Each university has one high-speed terminal as well as several other medium and low-speed devices located in key positions on campus. The input-output terminals are connected to the Model 165 by telecommunication lines.

The high-speed terminal at North Carolina State University is an IBM 360, Model 40 located at the Computing Center in the Nelson Textile Building. It provides communication with TUCC and simultaneously processes many of the administration's data processing applications. Many other terminals, both small computers and typewriter-type, are located on the campus. They and the Model 40 are used for faculty and student research and for instruction in scheduled credit courses and noncredit courses. Each of the eight schools and an increasing number of their departments are finding these facilities to be an important tool in the total educational process for their students.

## MILITARY EDUCATION AND TRAINING

### DEPARTMENT OF MILITARY SCIENCE (ARMY ROTC)

*Professor:* COLONEL W. L. BOYLSTON; *Instructors:* LTC R. E. CONROY, MAJOR A. A. JONES, CPT P. J. TUOHIG, CPT R. N. MOORE, CPT G. W. JOHNSON, MAJOR R. S. WILLIAMS JR.

### DEPARTMENT OF AEROSPACE STUDIES (AIR FORCE ROTC)

*Professor:* COLONEL DAVID F. FIRST; *Instructors:* MAJOR J. D. WINGFIELD, CAPT H. M. BADDLEY JR., CAPT C. T. FARMER

### OBJECTIVES

The Reserve Officers' Training Corps designates University students who are to be enrolled in the Department of Military Science (Army ROTC) or in the Depart-

ment of Aerospace Studies (Air Force ROTC). These departments are integral but separate academic and administrative subdivisions of the institution.

The mission of the Army ROTC program is to produce well-educated commissioned officers in sufficient numbers to meet Army requirements.

The mission of the Air Force Reserve Officer Training Corps (AFROTC) is to commission, through a college campus program, second lieutenants in response to Air Force officer requirements.

## **COURSE OF INSTRUCTION**

*Army ROTC*—The program of instruction for the Army ROTC consists of a two-year basic course and a two-year advanced course. Also available is a two-year program designed for junior college graduates, and students at four-year colleges who were unable to take ROTC during their first two years of college.

*Air Force ROTC*—The program of instruction for the Air Force ROTC consists of a two-year general military course, field training course and a two-year Professional officer course.

Students desiring to enter either the Army or Air Force two-year program should contact the Military Science Department, Room 160, Reynolds Coliseum, or the Aerospace Studies Department, Room 145, Reynolds Coliseum, before the start of the spring semester of their sophomore year.

The Army and Air Force ROTC units conduct a flight instruction program. A limited number of highly qualified cadets participate in this instruction which includes approximately 36½ hours of flying in light aircraft plus ground school incident to that training. (All Air Force ROTC cadets who are qualified and have volunteered for active duty pilot training pursue this instruction.) Successful completion of the light aircraft instruction may qualify cadets for a Federal Aviation Agency private pilot's certificate.

Satisfactory completion of the advanced courses qualifies a student for commissioning as a second lieutenant in the Army or Air Force Reserve upon graduation from the University. A detailed description of all military courses is given under each of the departments in the section of the catalog which lists course descriptions.

## **ARMY ROTC**

The selection of advanced-course students is made from applicants who are physically qualified and who have above average academic and military records. Veterans who have one year or more of service in the Armed Forces are eligible for enrollment in the Army ROTC advanced course upon reaching their junior year, provided they are in good academic standing, physically qualified, have not reached their 27th birthday and are selected by the PMS and the University administration.

The Army ROTC course includes instruction in American military history, map reading, leadership, military teaching methods, military justice, troop movements, the role of the U. S. in world affairs, administration, operations and logistics. These subjects not only prepare students to be officers in the United States Army, but also awaken in them an appreciation of the obligations of citizenship and secure for them personal benefits resulting from practical application of organization and responsible leadership.

## **AIR FORCE ROTC**

A student enrolled in the Air Force ROTC may pursue a four-year program or a two-year program. Both offer the opportunity for receiving an AFROTC scholarship.

Students, to meet enrollment requirements for the professional officer course, must achieve a qualifying score on the Air Force Officer Qualification Test (AFOQT), meet necessary physical requirements and must have good academic records. Qualified veterans desiring a commission through the Air Force ROTC program are required to complete the two-year advanced program and, in most

cases, attend four weeks of field training. Non-veterans must complete the two-year general military course, the two-year professional officer course, and attend four weeks of field training. Non-veterans may elect to successfully complete six weeks field training and the two-year professional officer course in lieu of the above four-year program. Both programs must be completed before their 30th birthday to qualify for a commission.

## UNIFORMS

Uniforms for Army and Air Force ROTC are provided by the University from commutation funds paid by the Federal Government.

## CREDIT

Credit is allowed for work at other institutions having an ROTC unit established in accordance with the provisions of the National Defense Act and regulations governing the ROTC. Record of a student's prior education and training in the ROTC is obtained from the institution concerned.

## FINANCIAL AID

*Army ROTC*—One-, two-, three- and four-year scholarships are available to selected Army ROTC students who are strongly motivated toward a career in the Army. Each scholarship pays for tuition, books and laboratory expenses, and the student receives \$100 a month for the duration of the scholarship.

*Air Force ROTC*—A limited number of selected students enrolled in the Air Force ROTC program may qualify for scholarships. All scholarships pay \$100 a month (tax-free) plus tuition, fees and reimbursement of textbook costs. In addition, all students in the last two years of the Air Force ROTC program receive a subsistence allowance of \$100 per month.

For summer training of four to six weeks, students will receive pay and travel allowance. Students in the Army basic or Air Force general military course other than scholarship students receive no monetary allowance.

## ORGANIZATION OF THE ROTC

*Army*—The Army ROTC unit at North Carolina State University consists of a cadet battalion, commanded by a cadet lieutenant colonel, and comprised of a headquarters company and lettered companies. The cadet lieutenant colonel and all other cadet officers are selected from students enrolled in the second year advanced course. Cadet sergeant majors, first sergeants and sergeants first class are appointed from students enrolled in the first year advanced course. Certain specially selected students in the second year basic course also are appointed as cadet non-commissioned officers. Cadet officers and non-commissioned officers obtain invaluable experience in leadership by being responsible for conducting all drill instruction. They are observed and supervised in this by the officers and non-commissioned officers of the Army assigned to the University.

*Air Force*—The Air Force ROTC unit is organized as a cadet group (commanded by a cadet colonel) with an appropriate number of squadrons; the squadrons are composed of flights and squads. The group, squadron and flight commanders and their staff are cadet commissioned officers and are selected from cadets enrolled in the professional officers course. All other positions are held by cadet non-commissioned officers who are selected from general military course cadets. Cadet officers and non-commissioned officers obtain invaluable experience in leadership by being responsible for planning and conducting all aspects of the cadet group operation. They are observed and supervised by the officers and airmen assigned to the University.

## **DISTINGUISHED STUDENTS**

The University is authorized to name outstanding students of the Army ROTC and Air Force ROTC as Distinguished Military Students or Distinguished Air Force ROTC Cadets. These students may, upon graduation, be designated Distinguished Military Graduates or Distinguished Air Force ROTC Graduates. The Distinguished Military Graduates may be selected for commission in the regular Army, provided they so desire.



*The D. H. Hill Library opens onto the University Plaza which is one of the busiest places on campus. Classrooms and a campus snackbar are conveniently located nearby.*

# COURSE DESCRIPTIONS

In a typical course description, the semester hours of credit, the number of actual lecture and laboratory hours of meeting per week, and the term or terms in which the course is offered are shown in this manner: 2 (1-2) F S Sum. or 1-3 F S Sum.

The 2 indicates the number of semester hours credit given for satisfactory completion of the course. The (1-2) indicates that the course meets for one hour of lecture and for two hours of laboratory work each week. The 1-3 indicates that a maximum of 3 and a minimum of 1 semester hours credit can be earned. This is to be arranged with the instructor. The F designates the course to be given the fall semester. Likewise, the S designates spring and the Sum., summer.

Waiver of prerequisites is at the descretion of the instructor.

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## ADULT AND COMMUNITY COLLEGE EDUCATION

### FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 500 THE COMMUNITY COLLEGE SYSTEM 3 (3-0) F  
Prerequisite: Graduate or advanced undergraduate standing

Comprehensive community colleges and technical institutes and the state systems of which they are a part: underlying concepts, educational needs they are designed to serve, role in meeting these needs, historical development, issues in the establishment and operation of state systems and individual institutions, unresolved issues and emerging trends. Graduate Staff

ED 501 (SOC 501) LEADERSHIP 3 (3-0) F S  
(See sociology, page 453.)

ED 502 (PS 502) PUBLIC ADMINISTRATION 3 (3-0) F S  
(See politics, page 432.)

ED 503 THE PROGRAMMING PROCESS IN ADULT AND  
COMMUNITY COLLEGE EDUCATION 3 (3-0) F S  
Prerequisites: ED 501, consent of instructor

The principles and processes involved in programming, including basic theories and concepts supporting the programming process. Attention will be given to the general framework in which programming is done, the organization needed and the program roles of both professional and lay leaders. Graduate Staff

ED 510 ADULT EDUCATION: HISTORY, PHILOSOPHY,  
CONTEMPORARY NATURE 3 (3-0) F  
Prerequisite: Graduate standing

A study of the historical and philosophical foundations of adult education from ancient times to the present, giving attention to key figures, issues, institutions, movements and programs, including consideration of the relationship between adult education's historical development and prevailing intellectual, social, economic and political conditions. Consideration of adult education's contemporary nature, present-day schools of thought on its objectives and trends. Graduate Staff

ED 513 (SOC 513) COMMUNITY ORGANIZATION 3 (3-0) F S  
(See sociology, page 454.)

ED 537	THE EXTENSION AND PUBLIC SERVICE FUNCTION IN HIGHER EDUCATION	3 (3-0) S
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Prerequisite: ED 510

An examination of the background, history, philosophy and contemporary nature of the extension and public service function of institutions of higher education in the United States. Emphasis is placed on the adult education role of public and private universities and colleges. Specific focus is on: General Extension, Industrial Extension, Engineering Extension, Cooperative Extension and Continuing Education.  
Graduate Staff

ED 538	INSTRUCTIONAL STRATEGIES IN ADULT AND COMMUNITY COLLEGE EDUCATION	3 (3-0) S
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Prerequisite: ED 559, Graduate standing

This course examines forms of instruction appropriate for the teaching of adults. Special emphasis will be placed upon methods which maximally involve the adult learner. The study of concepts, theories, and principles relevant to the selection, utilization, and evaluation of instructional strategies will focus on the integration of theory into practice. Through participation in classroom exercises, the student will develop proficiency in using teaching techniques which are applicable in adult and community college education.  
Graduate Staff

ED 559	LEARNING CONCEPTS AND THEORIES APPLIED TO ADULT AND COMMUNITY COLLEGE EDUCATION	3 (3-0) S
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Prerequisite: Six hours in education

Principles involved in adult education programs including theories and concepts undergirding and requisite to these programs. Emphasis will be given to the interrelationship of the nature of adult learning, the nature of the subject matter and the setting in which learning occurs. The applicability of relevant principles and pertinent research findings to adult learning will be thoroughly treated.  
Graduate Staff

ED 596	TOPICAL PROBLEMS IN ADULT AND COMMUNITY COLLEGE EDUCATION	Credits Arranged
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Prerequisite: Graduate standing

Study and scientific analysis of problems in adult education, and preparation of a scholarly research type of paper.  
Graduate Staff

ED 598	CONCEPTS AND STRATEGIES OF UNDERSTANDING, MOTIVATING AND TEACHING DISADVANTAGED ADULTS	3 (3-0) S
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Prerequisite: Graduate standing, consent of instructor

Designed to help adult educators acquire a comprehensive understanding of the educational, psychological social, cultural, and economic problems of the culturally deprived segments of society. In-depth explorations of the theoretical basis for understanding, motivating and teaching disadvantaged adults will be interwoven with practical applications of these bases to specific educational opportunities with the disadvantaged adult learner.  
Graduate Staff

## FOR GRADUATES ONLY

ED 600	ORGANIZATIONAL CONCEPTS AND THEORIES APPLIED TO ADULT AND COMMUNITY COLLEGE EDUCATION	3 (3-0) F
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ED 601	ADMINISTRATIVE CONCEPTS AND THEORIES APPLIED TO ADULT AND COMMUNITY COLLEGE EDUCATION	3 (3-0) S
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ED 696	SEMINAR IN ADULT AND COMMUNITY COLLEGE EDUCATION	1-3 F S
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# AGRICULTURAL EDUCATION

## FOR UNDERGRADUATES

### ED 102 OBJECTIVES IN AGRICULTURAL EDUCATION 1 (1-0) F S

Designed to help the student understand the purpose of agricultural education at North Carolina State. Also provides an opportunity for students to develop an understanding of purposes of vocational agriculture and other programs of education in agriculture. Mr. Bryant

### ED 313 CONTEMPORARY VOCATIONAL AGRICULTURE 3 (3-0) F S

The contemporary program of vocational agriculture is examined in depth in relation to changing and expanding career opportunities in agricultural education. Study is directed to the continuing adjustment of the program objectives, curriculum organization, content of courses, teaching practices, instructional resources and evaluation emphasis in modern programs in vocational agriculture. Prerequisite for student teaching in agricultural education. Mr. Bryant

### ED 411 STUDENT TEACHING IN AGRICULTURE 8 (2-15) F S

Prerequisites: ED 344, PSY 304, senior standing, admission to teacher education and an overall 2.0 average

The first part of the semester, six or seven weeks, will be on campus. The remainder of the semester will be spent in a high school doing full-time student teaching. The student will get experience in all phases of the vocational agriculture program, including community study, adult education and home supervision. The student teacher will be supervised by the local teacher of agriculture and a member of the staff in agricultural education. Mr. Scarborough

### ED 412 TEACHING ADULTS 2 (1-2) F S

Principles of effective teaching applied to adults. Experience in organizing and conducting groups for discussion of local problems. Mr. Miller

### ED 413 PLANNING EDUCATIONAL PROGRAMS 2 (1-2) F S

Principles of program planning applied to educational programs in agriculture. Resources needed for adequate planning. Field work in planning programs.

### ED 490 SENIOR SEMINAR IN AGRICULTURAL EDUCATION 1 (1-0) F S

An analysis of the opportunities and problems facing educational leaders in agriculture with particular emphasis upon current problems. Staff

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

### ED 554 PLANNING PROGRAMS IN AGRICULTURAL EDUCATION 3 (3-0) F S

Prerequisite: ED 411 or equivalent

Consideration of the need for planning programs in education; objectives and evaluation of community programs; use of advisory group; organization and use of facilities. Mr. Bryant

### ED 565 AGRICULTURAL OCCUPATIONS 3 (3-0) F S

Prerequisite: ED 411

The theory of education and work is related to the expanding field of agricultural occupations. Career development in agricultural occupations is associated with curriculum development needs. Occupational experience in agriculture is seen in relation to the curriculum and to placement in agricultural occupations.

Messrs. Miller, Scarborough

**ED 566 OCCUPATIONAL EXPERIENCE IN AGRICULTURE**  
Prerequisite: ED 411

3 (3-0) F S

A major and critical element in all programs of vocational education is the provision for appropriate student learning experiences in a real and simulated employment environment. Due to recent developments in education and agriculture, new and expanded concepts of occupational experience have been devised. Current research substantiates the need and desire of teachers of agriculture for assistance in implementing the new concepts. The course is designed not only to provide this aid but to develop a depth of understanding of the theoretical foundations underlying the new developments in occupational experiences to stimulate individual growth and creativity in implementing further developments.

Mr. Miller

**ED 568 ADULT EDUCATION IN AGRICULTURE**  
Prerequisite: ED 411 or equivalent

3 (3-0) F S

Designed to meet the needs of leaders in adult education. Opportunity to study some of the basic problems and values in working with adult groups. Attention will be given to the problem of fitting the educational program for adults into the public school program and other educational programs as well as to the methods of teaching adults.

Mr. Scarborough

**ED 593 SPECIAL PROBLEMS IN AGRICULTURAL EDUCATION**  
Prerequisite: ED 411 or equivalent

Credits Arranged

Opportunities for students to study current problems under the guidance of the staff.

Staff

**ED 597 SPECIAL PROBLEMS IN EDUCATION**

1-3 F S Sum.

Prerequisite: Graduate standing and permission of instructor

The major purpose of this course is to help teachers and others involved in occupational exploration programs to further develop their understandings and competencies in these areas. The approach will be based upon an understanding of the philosophy underlying the world of work and the role of occupational exploration in educational programs for young people.

Messrs. Scarborough, Bryant

## **FOR GRADUATES ONLY**

**ED 617 PHILOSOPHY OF AGRICULTURAL EDUCATION**

3 (3-0) S

**ED 664 SUPERVISION IN AGRICULTURAL EDUCATION**

3 (3-0) F S

**ED 688 RESEARCH APPLICATION IN OCCUPATIONAL EDUCATION**

3 (3-0) F S Sum.

**ED 689 EVALUATION IN OCCUPATIONAL EDUCATION**

3 (3-0) F S

**ED 693 ADVANCED PROBLEMS IN AGRICULTURAL EDUCATION**

Credits Arranged

**ED 694 SEMINAR IN AGRICULTURAL EDUCATION**

1 (1-0) F S

**ED 699 RESEARCH**

Credits Arranged Maximum 2

## **AGRICULTURE AND LIFE SCIENCES**

### **General Courses**

**ALS 103 ORIENTATION**

1 (0-2) F

An introduction to the scope and objectives of a university education with empha-

sis on the sciences particularly as related to biology and agriculture. Guest lectures and laboratory demonstrations. Mr. Glazener

ALS 299 SUPERIOR STUDENT SEMINAR 1 S Maximum 2  
Prerequisite: Freshman and sophomore honor students

A seminar program open only to freshmen and sophomore students in the honors program. Participation is by invitation.

ALS 490 (LA 490) INTERNATIONAL SEMINAR 1 (1-0) F S  
Prerequisite: Juniors and seniors, upperclassmen interested in international affairs.

This course will consist of weekly series of seminar sessions on the economic and social aspects of developing countries. Open to junior and senior students.

ALS 499 HONORS STUDENT RESEARCH 1-3 S Maximum 6  
A research program open only to junior and senior students in the honors program. Participation is by invitation.

AC 311 COMMUNICATIONS METHODS AND MEDIA 3 (3-0) S  
Prerequisites: ENG 111, ENG 112

Designed to give an insight into the communications process: written, oral and visual techniques of communications; a survey of the channels of communications available; principles and techniques for using these channels individually or combined into a publicity, promotion, public relations, information or advertising program. Mr. Carpenter

## ANIMAL SCIENCE

### FOR UNDERGRADUATES

ANS 200 INTRODUCTION TO ANIMAL SCIENCE 4 (3-3) F S  
A study of the fundamental principles of dairying and of meat animal production. The importance of dairy and meat products in the human diet and in the state and national economy is emphasized. Messrs. Goode, Rakes

ANS 204 LIVESTOCK FEEDS AND FEEDING 3 (2-3) S  
An introduction to applied animal nutrition, including the structure and function of the digestive tract, the nutrient value and classification of feedstuffs and the nutrient requirements and formulation of livestock rations. Mr. Leatherwood

ANS 301 (FS 301, NTR 301) NUTRITION AND MAN 3 (3-0) F S  
Prerequisite: Two years of college work  
The significance of nutrition in the health, welfare and behavior of man; a study of the basic principles relating to practical problems in the provision and utilization of adequate nutrients for individuals and populations living under various environmental conditions. Messrs. Wise, Aurand

ANS 302 SELECTING DAIRY AND MEAT ANIMALS 2 (0-6) S  
Market classes and grades of beef cattle, swine and sheep are used to study live animal-car carcass value interrelationships. Breed histories, pedigree evaluation and the desired characteristics of dairy cattle, meat animals and quarter horses are examined. Messrs. Harvey, Wilk

ANS 308 ADVANCED SELECTING DAIRY AND MEAT ANIMALS 1 (0-3) F  
Prerequisite: ANS 302 or consent of instructor

An advanced study of dairy and meat animal selection, including the relationships between the live animal and its carcass. Included is intensive practice to

develop proficiency in the selection of market and purebred livestock. Field trips are made to leading farms in order to study outstanding animals of the various breeds.

Messrs. Harvey, Wilk

## FOR ADVANCED UNDERGRADUATES

### ANS 401 REPRODUCTIVE PHYSIOLOGY

3 (2-3) S

Prerequisite: ZO 421

Current concepts of physiology as related to mammalian reproduction. Emphasis is placed upon understanding physiological processes, how they are influenced by external forces and their importance in reproductive performance. The student may be required to select, design and conduct a special research project.

Messrs. Myers, Johnson

### ANS 402 BEEF CATTLE MANAGEMENT

3 (2-3) S

Prerequisite: ANS 204

A study of modern principles and practices in beef cattle care and management. Special emphasis is placed upon the application of principles of genetics, ruminant nutrition and animal health to cow-calf programs and to stocker and feeder cattle operations.

Mr. Harvey

### ANS 403 SWINE MANAGEMENT

3 (2-3) S

Prerequisite: ANS 204

A study of the economic, nutritional, genetic, physiological and managerial factors affecting the operation of modern swine enterprises.

Mr. Coalson

### ANS 404 DAIRY CATTLE MANAGEMENT

3 (2-3) S

Prerequisite: ANS 204

A study of practical dairy farm management, including feed acquisition and utilization, breeding and selection, health and sanitation, herd replacements and dairy farm buildings. Particular emphasis is placed upon the consequences of management alternatives and the importance of herd and farm business records. (Offered spring 1974 and alternate years.)

Mr. Davenport

### ANS 405 LACTATION

3 (2-3) F

Prerequisite: ZO 421

Gross and microscopic anatomy of the developing and the mature mammary gland. Physiological processes involved in milk secretion and the removal of milk from the gland are studied. A special research problem is required.

Mr. Mochrie

### ANS 406 SHEEP MANAGEMENT

3 (2-3) F

Prerequisite: ANS 204

A study of the economic, genetic, nutritional, physiological and managerial factors affecting the operation of the modern sheep enterprise.

Mr. Goode

### ANS 409 (FS 409) MEAT AND MEAT PRODUCTS

3 (2-3) S

(See food science, page 335.)

### ANS 410 HORSE MANAGEMENT

3 (2-2) F

Application of fundamentals of selection, nutrition, breeding and animal health to light horses. Managerial details of horses are covered.

Mr. Barrick

### ANS 411 BREEDING AND IMPROVEMENT OF DOMESTIC ANIMALS

3 (2-2) F

Prerequisite: GN 411

Genetic principles are stressed in relation to the improvement of economically

important domestic species. Emphasis is given to the specific requirements of breeding plans for individual species. Mr. McDaniel

ANS 415 (NTR 415, PO 415) COMPARATIVE NUTRITION 3 (3-0) F  
Prerequisite: CH 220 or CH 221

Fundamentals of animal nutrition, including the classification of nutrients; their requirement and general metabolism by different species for health, maintenance, growth and other productive functions. Messrs. Ramsey, Donaldson

ANS 416 (NTR 416) QUANTITATIVE NUTRITION 3 (1-6) F  
Prerequisite: BCH 351 or equivalent

Quantitative principles are applied to the study of nutrition by using animals and microorganisms in practical experiments. Messrs. Smith, Jones

ANS 490 ANIMAL SCIENCE SEMINAR 1 (1-0) S

Review and discussion of special topics and current literature pertaining to all phases of animal science. Mr. Porterfield

## GRADUATES AND ADVANCED UNDERGRADUATES

ANS 502 (PHY 502) REPRODUCTIVE PHYSIOLOGY OF VERTEBRATES 3 (3-0) S  
Prerequisite: ZO 421 or consent of instructor

Emphasis is placed upon discussion of mechanisms which control the reproductive processes. Mechanisms which are species-limited are compared with those which are shared by all. Current knowledge of some subsystems is investigated in detail, while others are referred to in reviews of well-documented research findings.

Mr. Ulberg

ANS 505 DISEASES OF FARM ANIMALS 3 (3-0) F  
Prerequisites: CH 101, CH 103

The pathology of bacterial, viral, parasitic, nutritional, thermal and mechanical disease processes. Mr. Batte

ANS 508 (GN 508) GENETICS OF ANIMAL IMPROVEMENT 3 (3-0) S  
Prerequisites: GN 411, ST 511

Emphasis is placed upon the utilization of basic principles of population and quantitative genetics in animal improvement. Factors affecting genic and genotypic frequencies and methods of estimating genetic and non genetic variance, heritabilities and breeding values are presented. The roles of mating systems and selection procedures in producing superior genetic populations are examined.

Mr. Robison

ANS 590 TOPICAL PROBLEMS IN ANIMAL SCIENCE Maximum 6 F S

Special problems are selected or assigned in various phases of animal science.

Graduate Staff

## FOR GRADUATES ONLY

ANS 603 (GN 603) POPULATION GENETICS IN ANIMAL IMPROVEMENT 3 (3-0) F

ANS 604 (PHY 604) EXPERIMENTAL ANIMAL PHYSIOLOGY 4 (2-4) F

ANS 622 (ST 622) PRINCIPLES OF BIOLOGICAL ASSAYS 3 (3-0) S

ANS 653 (BCH 653) MINERAL METABOLISM 3 (3-0) F

ANS 690 SEMINAR IN ANIMAL NUTRITION 1 (1-0) F S

ANS 699 RESEARCH IN ANIMAL SCIENCE Credits Arranged F S

# **ANTHROPOLOGY**

**(Also see Sociology)**

## **FOR UNDERGRADUATES**

**ANT 251 PHYSICAL ANTHROPOLOGY** 3 (3-0) F S

The study of the development of man as a species; analysis of the formation and spread of races; introduction to archaeology as a study of the material remains of ancient man and his activities.

**ANT 252 CULTURAL ANTHROPOLOGY** 3 (3-0) F S

The analysis of various living societies and their cultures in terms of social adjustment to recurrent needs.

**ANT 305 PEOPLES OF THE WORLD** 3 (3-0) F S

This course seeks to develop insights of wide applicability concerning human relationships and the adjustment of man to his geographical, social and cultural environments. The course is designed to demonstrate interrelationships among diverse factors affecting human behavior in all societies.

**ANT 410 THEORIES OF CULTURE** 3 (3-0) F S

Prerequisites: Six hours sociology, ANT 252 or equivalent

The study of major anthropological theories of culture with intensive analysis of their application.

**ANT 416 FIELD METHODS IN CULTURAL ANTHROPOLOGY** 3 (3-0) F S

Prerequisite: Six hours anthropology

I. To provide a systematic experience with anthropological field techniques, i.e., community mapping; household census; kinship analysis; life-history recording; participant observation; inventory of material culture; child rearing observation. II. To furnish an opportunity to use conventional anthropological field tools, i.e., tape recorder, motion picture camera, still camera, fieldwork journal, unstructured interview. III. Through textbooks and supplementary reading, students will become familiar with anthropologists' reports of their own field methods and the problems they encountered.

## **FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**ANT 512 APPLIED ANTHROPOLOGY** 3 (3-0) F S

Prerequisite: ANT 252 or consent of instructor

The course includes a review of the historical development of applied anthropology and a study of anthropology as applied in government, industry, community development, education and medicine. The processes of cultural change are analyzed in terms of the application of anthropological techniques to programs of developmental change.

## **ARCHITECTURE**

**ARC 300 HISTORIC ARCHITECTURE RESEARCH** 2 F S

Prerequisite: DN 202

Research and the recording of sites, monuments, buildings or artifacts of historical interest.  
Mr. Reuer

ARC 315 (EM 315) ARCHITECTURAL MECHANICS I 3 (2-3) F  
Prerequisites: One semester of calculus; recommended PY 221 or equivalent

An introduction to the mechanics of architectural structures: a lecture-workshop course in which the determinants of architectural form are related to structural function through a study of mechanics; principles of statics including particle and rigid body mechanics, force systems, equilibrium, and internal force systems. Lectures will present concepts and methods; workshops will provide an opportunity for application and exploration of lecture material. Staff

ARC 316 (EM 316) ARCHITECTURAL MECHANICS II 3 (2-3) S  
Prerequisite: ARC 315 (EM 315)

A continuation of ARC 315 (EM 315): a lecture-workshop course which investigates the mechanical properties of construction materials and the purpose, geometrical characteristics, behavior, and design of structural elements. Lectures will present concepts and methods; workshops will provide opportunity for application and exploration of lecture material. Staff

ARC 331 ENVIRONMENTAL BUILDING SYSTEMS 2 (1-3) F S

The establishment and development of the concept of building as an environmental control mechanism, i.e., as a barrier between the natural environment and the activities and human needs to be accommodated. A description of environmental factors upon which the science of building construction is based. An investigation of basic building materials, their properties, processes of production and principal systems of enclosure. Consideration will also be given to economic factors and legal controls. Mr. Aho

ARC 332 ENVIRONMENTAL CONTROL SYSTEMS 2 (1-3) F S

A study of the basic systems used to control the environment: air, heat, light, sound and sanitation. Emphasis placed upon the principles and the conceptual understanding of each system through comparative analysis of the system's characteristics and the investigation of the effect of each system on architectural form. Mr. Barnes

ARC 400 INTERMEDIATE ARCHITECTURAL DESIGN (SERIES) 4 (1-9) F S  
Prerequisite: DN 202 or equivalent or consent of department

Design investigations aimed at the development of an understanding of the major issues confronting the contemporary architect and at the expanding of problem-solving abilities in architectural design. Students must complete four semesters to satisfy this requirement, selecting from a number of vertically organized workshops which offer on an optional basis a wide range of program emphases. Staff

ARC 415 (CE 415) ARCHITECTURAL STRUCTURES I 3 (2-3) F  
Prerequisite: ARC 316 (EM 316)

Not open to civil engineering students.

Fundamental concepts underlying the behavior of statically determinate building systems; investigation of the design and construction techniques used in steel and timber framing. Lectures will present concepts and methods; workshops will provide an opportunity for application and exploration of lecture material. Staff

ARC 416 (CE 416) ARCHITECTURAL STRUCTURES II 3 (2-3) S  
Prerequisite: ARC 415 (CE 415)

Not open to civil engineering students.

Fundamental concepts underlying the behavior, analysis, and design of statically indeterminate building systems; investigation of the design and construction techniques used in framing; analysis procedures for indeterminate structural elements; application of design with emphasis on reinforced concrete construction.

A terminal design project provides an opportunity for a synthesis of the four semester structures sequence. Lectures will present concepts methods; workshops will provide an opportunity for application and exploration of lecture material.

Staff

#### ARC 431 INDUSTRIALIZED SYSTEMS BUILDING

2 (1-3) F S

Prerequisite: ARC 331

An analytic study of mass produced building systems to examine the implications, limitations and potentials of this type of architecture. The analysis is to include design, factory processes, distribution methods, fabrication, erection and economic analysis.

Staff

#### ARC 432 CLIMATE CONTROL SYSTEMS AND DESIGN

2 (1-3) F

Prerequisite: ARC 332

Further study of the mechanical systems used for heating, cooling, ventilating and conditioning the interior of buildings. The analysis and design of the climate control system for a small-scale building will be undertaken in this course.

Mr. Barnes

#### ARC 433 ILLUMINATION DESIGN

2 (1-3) S

Prerequisite: ARC 332

Examination of interior and exterior lighting design, including vision, color, sources and control.

Mr. Barnes

#### ARC 441 DESIGN METHODS

2 (2-0) F S

Description, comparisons and testing of the various methods which are available in architectural design with emphasis on problem-solving techniques. The method is primarily a means for integrating rational analysis and creative thought in the design act.

Staff

#### ARC 491 SPECIAL PROJECTS IN ARCHITECTURE

1-4 F S

Prerequisite: Junior standing

Investigation of special projects by interdisciplinary groups or individuals in various phases of architecture.

Staff

#### ARC 495 SPECIAL PROBLEMS IN ARCHITECTURE

1-3 F S

Prerequisite: Junior standing

Special problems in various aspects of architecture developed under the direction of a faculty member on a tutorial basis.

Staff

#### ARC 499 ARCHITECTURE SEMINAR

1-3 F S

Prerequisite: Consent of department

Presentations and discussions of special areas of interest in architecture and the allied design fields.

Staff

### FOR GRADUATES AND ADVANCED UNDERGRADUATES

#### ARC 501, 502 ADVANCED ARCHITECTURAL DESIGN I, II

6 (3-9) F S

Prerequisites: (501) 16 credits of ARC 400 or equivalent; (502) ARC 501

Advanced studies in architectural design in which are investigated large-scale architectural problems having complex functional, social and economic implications; special emphasis is given to problem identification, program formulation and application of advanced design methods.

Messrs. Batchelor, Burns, Sanoff

#### ARC 511 PROFESSIONAL PRACTICE I

2 (2-0) F S

Prerequisite: Fourth year standing

The evolution of architecture as a modern practical profession; obligations of the

profession to society and to itself; the legal and ethical position of the architect in practice; comparative study of documents; the architect's working organization; emerging techniques of office practice. Staff

**ARC 512 PROFESSIONAL PRACTICE II**

2 (2-0) S

Prerequisite: Fourth year standing

Continuing study of standard documents and emerging techniques of practice, with emphasis on the principles and improved techniques of writing construction specifications; interrelationships of The Contract Documents; comparative study of techniques of controlling competitive bidding. Staff

**ARC 521, 522 ADVANCED ARCHITECTURAL STRUCTURES I, II**

3 (3-0) F S

Prerequisites: (521) ARC 416 (CE 416); (522) ARC 521

Gravity and nongravity loads on structures; comparative behavior of structural materials; comparative behavior of simple structural systems; approximate and exact analysis procedures as applied to systems; principles of approximate and exact design in timber, steel and reinforced concrete; architectural/structural/mechanical compatibility in systems; basic principles of foundation analysis and design. Mr. Brantly

**ARC 531, 532 ADVANCED BUILDING TECHNOLOGY I, II**

2 (1-3) F S

Prerequisites: ARC 331, ARC 332

A synthesis of studies in building science undertaken in previous courses. Material assemblies in practical application, dimensional characteristics of mechanical and construction systems for buildings and special projects in selected areas of building science. Staff

**ARC 551 RESEARCH METHODS IN ARCHITECTURE**

2 (2-0) F S

Prerequisite: Graduate standing

Seminar on the quantitative methods from various disciplines towards the scientific inquiry of knowledge. Analysis of techniques and instruments appropriate in solving problems involving scaling, measurement, modeling and gaming within the scope of the physical environment.

**ARC 591, 592 ADVANCED TOPICS IN ARCHITECTURE I, II**

1-4 F S

Prerequisite: Advanced or graduate standing in School of Design or departmental approval

Investigations of advanced topics in specialized aspects of architecture for interested advanced undergraduate and graduate students in the School of Design.

**FOR GRADUATES ONLY**

**ARC 601, 602 ADVANCED ARCHITECTURAL DESIGN III, IV**

6 (3-9) F S

**ARC 621, 622 ADVANCED ARCHITECTURAL STRUCTURES III, IV**

2 (1-3) F S

**ARC 691, 692 SPECIAL TOPICS IN ARCHITECTURE**

Arranged 1-6 F S

**ART**

**ART 200 THE VISUAL ARTS IN CONTEMPORARY LIFE**

3 (3-0) F

The study of painting, sculpture, art crafts and the useful arts of commerce. Also, the study of the aesthetic nature of man from the standpoint of creativity and appreciation; relation of present day creative efforts of man with those of the past—giving the student an understanding of today's visual arts. Staff

# BIOCHEMISTRY

## FOR UNDERGRADUATES

BCH 351 ELEMENTARY BIOCHEMISTRY 3 (3-0) S  
Prerequisite: CH 223 (may be taken concurrently)

A survey course that presents an introduction to the basics of biochemistry and to the various areas of research the discipline encompasses. Mr. Armstrong

BCH 452 EXPERIMENTAL BIOCHEMISTRY 3 (1-6) F  
Prerequisite: BCH 351, or corequisite BCH 551; quantitative chemical analysis recommended

Fundamental techniques of biochemistry and molecular biology involving experimental study of carbohydrates, lipids, proteins, enzymes, nucleic acids, metabolism, and metabolic controls. Complements BCH 551, which may be taken concurrently. Mrs. Theil

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

BCH 551 GENERAL BIOCHEMISTRY 3 (3-0) F  
Prerequisites: Three years of chemistry including CH 223 or equivalent; CH 431 strongly recommended

Principles of biochemistry including a study of structural and metabolic relationships of carbohydrates, lipids, proteins, nucleic acids, enzymes and coenzymes, and an introduction to the mechanisms involved in regulation of enzyme activity and protein synthesis. Designed to accompany BCH 452. Mr. Jones

BCH 553 (PHY 553) PHYSIOLOGICAL BIOCHEMISTRY 3 (3-0) S  
Prerequisite: BCH 551

Emphasis on the application of biochemical methods to the elucidation of the function of whole organisms. In particular, A. Biochemistry of 1) blood, 2) water, electrolyte, acid-base balance, 3) renal function, 4) muscle metabolism, 5) central nervous system, 6) autonomic nervous system, and 7) endocrine system. B. Biochemistry of adaptation to environment, i.e., 1) high and low  $P_{O_2}$ , 2) hot and cold, 3) wet and dry, and 4) pollution. Mr. Longmuir

BCH 554 RADIOISOTOPE TECHNIQUES IN BIOLOGY 2 (1-3) F  
Prerequisite: BCH 551 or CH 433 or CH 435

The theory and application of radioisotope techniques used in biology. The different modes of radioactivity are correlated with methods of measurement. Emphasis is placed on the use and limitations of various instruments and techniques and on their application to research problems. Mr. Sisler

BCH 557 INTRODUCTORY ENZYME KINETICS 3 (3-0) S  
Prerequisites: BCH 551 and MA 201 or MA 212

The basic principles of chemical kinetics applied to the development of enzyme kinetics. Limitations of the Michaelis equation are considered in light of the general rate equation. Inhibition and activation, pH functions, effects of temperature, and elucidation of mechanisms are also considered. Mr. Main

BCH 561 (GN 561, MB 561) BIOCHEMICAL AND MICROBIAL GENETICS 3 (3-0) F  
Prerequisites: BCH 351 or BCH 551, GN 411 or GN 505, MB 401 or equivalent

A study of the development of the fields of biochemical genetics and microbial genetics emphasizing both techniques and concepts currently used in research in these areas. Includes lectures and discussions of current research publications. Mr. Armstrong

BCH 590 SPECIAL TOPICS IN BIOCHEMISTRY  
Prerequisite: BCH 351 or equivalent

Credits Arranged F S Sum.  
Maximum 3

The study of topics of special interest by small groups of students instructed by members of the faculty, usually for the purpose of developing new courses.

Graduate Staff

## FOR GRADUATES ONLY

BCH 651	PHYSICAL BIOCHEMISTRY	3 (3-0) S
BCH 652	BIOCHEMICAL RESEARCH TECHNIQUES	3-5 S
BCH 653	(ANS 653) MINERAL METABOLISM	3 (3-0) F
BCH 655	INTERMEDIARY METABOLISM I	3 (3-0) S
BCH 657	INTERMEDIARY METABOLISM II	3 (3-0) F
BCH 659	(CH 659) NATURAL PRODUCTS	3 (3-0) F
BCH 691	SEMINAR IN BIOCHEMISTRY	1
BCH 695	SPECIAL TOPICS IN BIOCHEMISTRY	Credits Arranged
BCH 699	BIOCHEMICAL RESEARCH	Credits Arranged

## BIOLOGICAL AND AGRICULTURAL ENGINEERING

### FOR UNDERGRADUATES

BAE 211	FARM MACHINERY	4 (2-4) F S
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The study of farm machinery which begins with the materials of construction as they are related to design, cost, fabrication process, tools and techniques involved in construction, repair and maintenance, machine performance, reliability, machine capabilities and limitations. The operation, service, and adjustment of the machine will be studied by an analysis of the requirements to do the job for which it was designed, and consideration of the conditions under which it must operate. The selection, management, and economics of owning and operating machinery is emphasized.

Mr. Howell

BAE 251	ELEMENTS OF BIOLOGICAL AND AGRICULTURAL ENGINEERING	3 (2-3) F
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Prerequisite: Enrollment in SBE curriculum

Elements of Biological and Agricultural Engineering is a course designed to introduce agricultural engineering students to pertinent topics basic to this field of study and to some of the current progress relating to the different subject areas. In addition, students will be introduced to various engineering procedures, tool processes, and materials utilized by the agricultural industries.

Mr. Blum

### FOR ADVANCED UNDERGRADUATES

BAE 303	ENERGY CONVERSION FOR AGRICULTURAL PRODUCTION	2 (2-0) F
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Prerequisites: BS 100, MA 112 or MA 201, PY 211 or PY 205

Energy transformations and exchanges of plants and animals are studied on the basis of physical theories and principles. Specific examples in thermal radiation, convection, conduction, phase changes, muscle work, photosynthesis, and respiration.

Mr. Suggs

**BAE 321 IRRIGATION, TERRACING AND EROSION CONTROL****3 (2-3) S****Prerequisite:** Junior standing

The principles of soil and water conservation engineering are examined. Topics discussed include surface and subsurface drainage, farm pond construction, open channel flow, soil erosion, conservation practices, irrigation, and the basic principles of surveying. Emphasis is placed on the practical application of these basic soil and water engineering concepts.

**Mr. Sneed****BAE 331 (FS 331) FOOD ENGINEERING****3 (2-3) F****Prerequisites:** PY 211 or PY 221

Engineering concepts and their application to the food industry will be presented. Principles of thermodynamics, fluid flow, heat transfer, refrigeration and electricity will be emphasized.

**Mr. Holmes****BAE 332 FARM STRUCTURES****3 (2-3) S****Prerequisite:** PY 211 or PY 221

This course is designed to acquaint the student with the role of farm structures in a rapidly changing agricultural situation. This, in turn, requires study of environmental relationships, materials flow, structural features, design techniques, construction materials and construction procedures. Emphasis is placed on relating the theory to practical applications encountered in problem situations.

**Mr. Blum****BAE 341 FARM ELECTRIFICATION AND UTILITIES****3 (2-3) S****Corequisite:** PY 212 or PY 221

A brief review of the development and present status of farm and rural electrification introduces a study of simple but basic electricity and its safe application through electric equipment and allied utilities to agricultural and farm enterprises. Fundamental farm wiring, circuit design, control and protection are carefully studied. Electric motors, water systems and the design of lighting, heating and ventilation systems for the farm and home are included in the course of study.

**Mr. Glover****BAE 342 AGRICULTURAL PROCESSING****4 (3-2) S****Prerequisite:** MA 301, MAE 301

Theory and application of heat and mass transfer to processing of agricultural crops. Topics emphasized will include psychrometrics, thin layer and deep bed drying, continuous-flow drying, and principles of biochemical processing. Problem sessions will demonstrate principles of fluid flow, materials handling, process control, and various drying systems.

**Messrs. Young, Johnson****BAE 361 ANALYTICAL METHODS****3 (2-2) F****Prerequisite:** MA 301**Corequisite:** EM 307

A course designed to develop the student's skill in problem solving, ranging from the standard approaches to the mechanical design of machine elements and mechanisms to innovative approaches to the design of whole machines and systems.

**Mr. Bowen****BAE 381 AGRICULTURAL STRUCTURES AND ENVIRONMENT****3 (2-3) S****Prerequisite:** EM 307, MAE 301

Principles of environmental control and structural analysis are combined with biological principles for the design of agricultural structures. Topics emphasized include physiological reactions of animals, plants and agricultural produce to their environment, applications of heat transfer and psychrometrics in calculating ventilation requirements and heating or cooling loads, structural analysis, material selection, agricultural waste management, and economic considerations of various structural alternatives.

**Mr. Baughman**

**BAE 391 ELECTROTECHNOLOGY IN BIOLOGICAL AND  
AGRICULTURAL ENGINEERING**

**3 (2-3) F**

**Prerequisite:** EE 331

Basic concepts for selecting and utilizing electromagnetic devices are covered in depth. Switching circuits and central circuits are discussed. Transducers and measurement techniques are related to agricultural problems. **Mr. McClure**

**BAE 411 FARM POWER AND MACHINERY**

**3 (2-3) S**

**Prerequisites:** BAE 211, PY 211 or PY 221

This course covers the application of heat engineering principles in the development and utilization of power of internal combustion engines, both spark ignition and diesel. Included are thermodynamic principles and a classification of these to the actual design and construction of engines, together with principles of carburetion and ignition. Power transmission units, hydraulics and hydraulic controls are emphasized. Power measurement and testing, and the economic utilization of power units are brought into the context of modern agriculture. **Mr. Fore**

**BAE 433 CROP PRESERVATION AND PROCESSING**

**3 (2-3) F**

**Prerequisite:** BAE 341

This course deals with the physical and biochemical characteristics of harvested crops and crop products as they define the requirements for the best preservation of quality. The properties of air-water vapor mixtures, the application of heat to air and crops, the characteristics and use of fans and heaters, the air flow requirements and measurement for crop preservation and materials handling will be studied. Feed preparation, mixing and handling are included in the course. **Mr. Young**

**BAE 451, 452 AGRICULTURAL ENGINEERING DESIGN I AND II**

**3 (1-6) F S**

**Prerequisite:** Senior standing in SBE curriculum

Design concepts are applied to current agricultural engineering problems. One major design project is combined with a variety of case studies and short term design problems to develop the student's confidence in his ability to do design work. **Mr. Holmes**

**BAE 461 ANALYSIS OF AGRICULTURAL PRODUCTION SYSTEMS**

**3 (3-0) F**

**Prerequisites:** MA 201, EC 205, CSC 111

A survey of methods of systems analysis and operations research with emphasis on applications to biological and agricultural problems. Topics discussed include: the systems approach to problem solving, intermediate economic analysis, basic concepts of probability, simulation, linear programming, and dynamic programming. **Mr. Sowell**

**BAE 462 FUNCTIONAL DESIGN OF FIELD MACHINES**

**3 (2-2) S**

**Prerequisites:** BAE 361, MAE 301, SSC 200

A study of the modern farm tractor and field machines. The emphasis of the course is on the translation of measurements of biological and physical factors of the agricultural production system into machine specifications that can be effectively converted into production machines by engineers of the manufacturing industry. **Mr. Bowen**

**BAE 465 (CHE 465) INTRODUCTION TO BIOMEDICAL ENGINEERING**

**3 (3-0) F**

(See chemical engineering page 269.)

**BAE 472 AGRICULTURAL WATER MANAGEMENT**

**4 (3-2) F**

**Prerequisites:** BS 100, SSC 200

Aspects of hydrology and soil-water-plant relationships as related to agricultural water management. Drainage and irrigation are discussed in depth. Water quality, agricultural related pollution, and water laws are discussed. **Mr. Skaggs**

**FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**BAE 552 INSTRUMENTATION FOR AGRICULTURAL RESEARCH AND PROCESSING** 2 (1-3) Alternate F  
Prerequisites: EE 331, MA 301

Theory and application of primary sensing elements and transducers. Generalized performance characteristics and the use of standards. Use of specialized measurement systems for agricultural research and processing including an introduction to correlation and power spectral density measurements. Mr. Rohrbach

**BAE 570 (CE 570, MB 570) SANITARY MICROBIOLOGY** 3 (2-3) S  
Prerequisite: MB 401 or equivalent

Fundamental aspects of microbiology and biochemistry are presented and related to problems of stream pollution, refuse disposal and biological treatment. Laboratory exercises present basic microbiological techniques and illustrate from a chemical viewpoint some of the basic microbial aspects of waste disposal. Mr. Humenik

**BAE 578 (CE 578) AGRICULTURAL WASTE MANAGEMENT** 3 (2-3) F  
Prerequisite: Graduate or advanced undergraduate standing

A study of agricultural and associated processing wastes. Special laboratory techniques required for the characterization of these wastes will be emphasized. Principles and examples considered will be utilized to develop waste management and nondestructive waste utilization systems that are integral to the total operation. Mr. Humenik

**BAE 580 ANALYSIS OF THE PHYSICAL PROPERTIES OF BIOMATERIALS** 3 (2-2) Alternate S  
Prerequisites: PY 205, PY 208

Physical characteristics—shape and size, volume and density, and surface area—of biomaterials, Aero- and hydro-dynamic characteristics (drag coefficient and terminal velocity) and dimensional analysis. Friction (static and rolling), particle mechanics and gravity and forced particle flow. Thermal properties (expansion and conductivity, specific heat), electrical properties (resistance and conductance, dielectric and electrostatic behavior), optical properties using transmittance and reflectance, and X-ray laser. Staff

**BAE 585 BIORHEOLOGY** 3 (2-2) Alternate S  
Prerequisites: PY 205, EM 307

The concepts of strain, stress and the mechanical viscoelastic properties of biological solids, fluids and slurries. The time-dependent deformation and flow of biomaterials, elements of strength of materials, rheological equations and model concepts, creep-relaxation and dynamic behavior, contact problems and the Boltzman superposition principle as a function of time, temperature and moisture content. Mr. Hamann

**BAE 590 SPECIAL PROBLEMS** Credits Arranged  
Prerequisite: Senior or graduate standing in agricultural engineering

Each student will select a subject on which he will do research and write a technical report on his results. He may choose a subject pertaining to his particular interest in any area of study in agricultural engineering. Staff

**FOR GRADUATES ONLY**

**BAE 654 NONEQUILIBRIUM THERMODYNAMICS IN BIOENGINEERING** 3 (3-0) Alternate S

BAE 661	ANALYSIS OF FUNCTION AND DESIGN OF BIOLOGICAL AND PHYSICAL SYSTEMS	3 (2-3) Alternate F
BAE 671	(SSC 671) THEORY OF DRAINAGE—SATURATED FLOW	3 (3-0) Alternate F
BAE 674	(SSC 674) THEORY OF DRAINAGE—UNSATURATED FLOW	3 (3-0) Alternate F
BAE 695	SEMINAR	1 (1-0) F S
BAE 699	RESEARCH IN BIOLOGICAL AND AGRICULTURAL ENGINEERING	Credits Arranged

## BIOLOGICAL SCIENCES

BS 100	GENERAL BIOLOGY	4 (3-3) F S
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Basic principles and concepts of biology, including the structure and function of cells and organisms, the organization and requirements of living systems, development, heredity and evolution.

BS 105	BIOLOGY IN THE MODERN WORLD	4 (3-3) F S
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An introduction to biology with chief emphasis on the applications and implications of biological knowledge for the solution of important social, economic and medical problems. Includes special consideration of man as a living organism and the role of man in the biological world. Intended mainly for students not majoring in the sciences.

BS 410	(ENT 410) BIOLOGY OF INSECTS (See entomology, page 330.)	3 (2-2) F
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BS 480	AIR POLLUTION BIOLOGY	3 (2-3) S
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Prerequisite: An introductory biological course and college chemistry, junior standing

The effects of air pollutants on biological systems at the subcellular, cellular, tissue, organ, individual and community level.

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

BS 500	(HI 500) THE DEVELOPMENT OF CONTEMPORARY CONCEPTS IN BIOLOGY	3 (3-0) S
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Prerequisite: General biology

Selected contemporary concepts of biology are traced from their origins. Considerable attention is given to the lives of the men who have made important contributions to the biological sciences.

## FOR GRADUATES ONLY

BS 590	SPECIAL PROBLEMS IN BIOLOGICAL INSTRUMENTATION	1-3 F S
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Prerequisite: Consent of instructor

BS 690	SEMINAR IN CELL BIOLOGY	1 (1-0) S
BS 696	TOPICS IN BIOLOGICAL ULTRASTRUCTURE	1 (1-0) F

**BIOMATHEMATICS**  
**FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**BMA 493 SPECIAL TOPICS IN BIOMATHEMATICS** 1-3 F S  
Prerequisite: Consent of instructor

Directed readings, problem sets, written and oral reports at an introductory level as dictated by need and interest of student; new 400 level courses during the developmental phase. Staff

**BMA 501 THEORETICAL BIOCHEMISTRY I** 3 (3-0) F  
Prerequisites: MA 405, CH 433, BCH 551 or consent of instructor

Application of physical theory and mathematics to biochemistry. Examination of basic principles of molecular theory, reaction rate theory, statistical mechanics and non-equilibrium thermodynamics as applied to biochemical systems. (Offered fall 1973 and alternate years.) Mr. Gold

**BMA 502 THEORETICAL BIOCHEMISTRY II** 3 (3-0) S  
Prerequisite: BMA 501

Continuation of BMA 501. Coupling of diffusion and chemical reactions. Mathematical description of enzyme control, coupled sequences of enzyme reactions, feedback loops and oscillatory reactions. Experimentally oriented topics include theory of chemical relaxation and tracer dynamics. (Offered spring 1974 and alternate years.) Mr. Gold

**BMA 571 (MA 571, ST 571) BIOMATHEMATICS I** 3 (3-0) F  
Prerequisites: Advanced calculus, reasonable background in biology or consent of instructor

The role of theory construction and model building in the development of experimental science. Induction vs. deduction. The historical development of mathematical theories and models for the growth of one-species populations (logistic and off-shoots), including consideration of age distributions (matrix theory, Leslie and Lopez; continuous theory, Lotka). Some of the more elementary theories on the growth of organisms (von Bertalanffy, with applications to ecology; allometric theories, cultures grown in a chemostat). Mathematical theories of two and more species systems (predator-prey, competition, symbiosis; acc. to the Volterra-Lotka schemes, including present-day research), and discussion of some related models for chemical reaction kinetics. Much emphasis is placed on scrutiny of the biological concepts as well as of the mathematical structure of the models in order to uncover both weak and strong points of the models discussed. Mathematical treatment of the differential equations in these models stresses qualitative and geometric aspects. Mr. van der Vaart

**BMA 572 (MA 572, ST 572) BIOMATHEMATICS II** 3 (3-0) S  
Prerequisites: BMA 571, Elementary probability theory

Continuation of topics of BMA 571. Some more advanced mathematical techniques concerning nonlinear differential equations of the types encountered in BMA 571: several concepts of stability, asymptotic directions, periodic models. Comparison of deterministic and stochastic models for several biological problems, including birth and death processes. Certain aspects of linear system theory (time-invariant and variable models) used for the analysis of biological systems. Discussion of various applications of mathematics to biology, e.g., theories of aging, some recent research. Mr. van der Vaart

**BMA 591 SPECIAL TOPICS** Maximum 3 F S  
Prerequisite: Consent of instructor

Directed readings, problem sets, written and oral reports as directed by need and

interest of student; new 500-level courses during the developmental phase.

Graduate Staff

## FOR GRADUATES ONLY

BMA 691 ADVANCED SPECIAL TOPICS

1-3 F S

BMA 694 SEMINAR

1 (1-0) F S

BMA 699 RESEARCH

Credits Arranged F S

## BOTANY

### FOR UNDERGRADUATES

BO 200 PLANT LIFE

4 (3-3) F S

A survey of the types of plants and their diversities in structure, life cycle, habitat, and economic importance.

Messrs. Witherspoon, VanDyke

BO 360 (ZO 360) INTRODUCTION TO ECOLOGY

4 (3-3) F S

Prerequisite: BS 100 or BS 105

The study of the relationships between organisms and their environment, and of the interaction among organisms. A balanced perspective in the basic principles of ecology and in their importance to man and his environment is presented. Content includes: ecosystems (energy flow and nutrient cycles); pollution; environment-organism interactions; population dynamics; interspecies ecology; communities; world biomes and paleoecology; and applied ecology.

Staff

BO 400 PLANT DIVERSITY

4 (3-3) F

Prerequisite: BO 200

A comprehensive survey of the evolutionary diversity and phylogeny of the plant kingdom. Emphasis is placed on the evolutionary trends and the basis for assumed relationships, considering fossils as well as living forms.

Mr. Hardin

BO 402 (CS 402) ECONOMIC BOTANY

3 (2-3) S

Prerequisite: BO 200

Emphasis is on plants and human affairs, rather than on taxonomy, production, or economics. Discussions center on all phases of the interrelationships of the plant world and the life history of incipient to modern human cultures. Treatment includes plants and plant products, beneficial and harmful, that man has used as necessities of life, as ameliorants contributing to his well-being, and as raw materials for industry. Ornamentals are excluded.

Mr. Timothy

BO 403 SYSTEMATIC BOTANY

4 (2-4) S

Prerequisite: BS 100 or BO 200

A systematic survey of vascular plants, emphasizing field identification, terminology and general evolutionary relationships.

Mr. Koch

BO 414 (ZO 414) CELL BIOLOGY

3 (3-0) F

(See zoology, page 481.)

BO 421 PLANT PHYSIOLOGY

4 (3-3) S

Prerequisites: BS 100 or BO 200, one year of college chemistry

Physiology of the green plant emphasizing plant organization, water and solute relationships, organic and inorganic nutrition, growth and development.

Messrs. Blum, Noggle, Troyer

**BO 499 INDEPENDENT STUDY IN BOTANY****1-3 FS**

Prerequisites: At least 8 hours of botany, advanced standing, and presentation of plan of work approved by a faculty member

Discussions, library research, field, or laboratory investigations of topics of particular interests to students under the direction of a faculty member on a tutorial basis. May be repeated for a maximum of six credits.

**Staff****FOR GRADUATES AND ADVANCED UNDERGRADUATES****BO 510 PLANT ANATOMY****4 (2-6) F**

Prerequisite: BO 200

A study of the cells, tissues and organs of common flowering plants and gymnosperms. Growth and differentiation patterns will be considered with emphasis on current research. (Offered fall, 1974.)

**Mr. Anderson****BO 522 ADVANCED MORPHOLOGY AND PHYLOGENY OF SEED PLANTS****4 (3-3) S**

Prerequisite: BO 403

A comprehensive survey of the morphology and evolution of angiosperms and gymnosperms. Special emphasis is given to detailed vegetative and reproductive morphology of fossil and living forms, and to their presumed evolutionary relationships. (Offered spring, 1974 and alternate years.)

**Mr. Hardin****BO 524 GRASSES, SEDGES, AND RUSHES****4 (2-6) F**

Prerequisite: BO 403

A course dealing with three large, economically and ecologically important plant families. A working familiarity with these three groups will be achieved through an introduction to the special terminology used in dealing with these plants, extensive field work emphasizing keying out plants collected, and a study of the recently developed modern classification of the grasses. (Offered fall, 1973 and alternate years.)

**Mr. Koch****BO 544 PLANT GEOGRAPHY****3 (3-0) S**

Prerequisites: BO 403, BO 360, GN 411, or equivalents

A course in descriptive and interpretive plant geography, synthesizing data from the fields of ecology, genetics, geography, paleobotany and taxonomy. The course will include a survey of the present distribution of major vegetation types throughout the world, a discussion of the history and development of this present pattern of vegetation, and a discussion of the principles and theories of plant geography. (Offered spring, 1973 and alternate years.)

**Mr. Cooper****BO 551 ADVANCED PLANT PHYSIOLOGY I****3 (3-0) F**

Prerequisites: General botany or biology, and biochemistry

The first half of a two-semester sequence covering the current status of plant physiology. Topics will include plant organization, metabolism, water relations, solute relations, photobiology and respiration.

**Mr. Troyer****BO 552 ADVANCED PLANT PHYSIOLOGY II****3 (3-0) S**

Prerequisites: General botany or biology, and biochemistry

The second half of a two-semester sequence covering the current status of plant physiology. Topics will include inorganic nutrition, nitrogen assimilation, plant growth substances, physiology of seeds, vegetative growth, reproductive growth, aging and senescence.

**Messrs. Blum, Troyer**

- BO 553 LABORATORY IN ADVANCED PLANT PHYSIOLOGY I 1 (0-3) F  
Prerequisite or corequisite: BO 551  
Laboratory to accompany BO 551. Laboratory procedures in plant nutrition, plant structure and composition, water relations, respiration. Mr. Troyer
- BO 554 LABORATORY IN ADVANCED PLANT PHYSIOLOGY II 1 (0-3) S  
Prerequisite or corequisite: BO 552  
Laboratory to accompany BO 552. Laboratory procedures in enzymes, photosynthesis, photobiology, plant growth substances. Messrs. Blum, Troyer
- BO 560 (ZO 560) PRINCIPLES OF ECOLOGY 4 (3-3) F  
(See zoology, page 484.)
- BO 561 PHYSIOLOGICAL ECOLOGY 4 (3-3) S  
Prerequisites: BO 421, BO (ZO 560), or equivalents  
This course will approach the plant community from a physiological standpoint. Emphasis will be placed on the individual in the community and how it responds to its immediate environment on a short- and long-term basis. (Offered spring 1973 and alternate years.) Mr. Blum
- BO 574 (MB 574) PHYCOLOGY 3 (1-4) S  
Prerequisite: BS 100 or BO 200  
An introduction to the classes of algae. The systematic position, life history and ecology of important genera in the local flora, both fresh-water and marine, are emphasized. Mr. Schlichting
- BO 575 (MB 575, PP 575) THE FUNGI 3 (3-0) S  
Prerequisite: BO 200 or equivalent  
An overview of the fungi within the framework of a survey of the major classes. Lectures while covering the major groups systematically will also include ancillary material on such aspects as ultrastructure, environmental adaptations, sexuality, ontogeny and economic, including historical, importance. Mr. Moore
- BO 576 (MB 576, PP 576) THE FUNGI—LABORATORY 1 (0-3) S  
Corequisite: BO 575  
The course will provide illustrative material of the fungal assemblages discussed in BO 575. Mr. Moore
- BO 590 TOPICAL PROBLEMS 1-3 F S  
Prerequisite: Consent of instructor  
Discussions and readings on problems of current interest in the fields of ecology, anatomy and morphology, taxonomy, and cell biology. May be repeated, with change in topic, for a maximum of six credits. Graduate Staff

## FOR GRADUATES ONLY

- BO 612 PLANT MORPHOGENESIS 4 (3-3) S
- BO 620 ADVANCED TAXONOMY 3 (2-2) S
- BO 625 (PP 625) ADVANCED MYCOLOGY 4 (2-6) F
- BO 631 WATER RELATIONS OF PLANTS 3 (3-0) S
- BO 633 PLANT GROWTH AND DEVELOPMENT 3 (3-0) S
- BO 634 INTRODUCTION TO THE THERMODYNAMICS OF BIOLOGICAL SYSTEMS 3 (3-0) S

BO 636	DISCUSSIONS IN PLANT PHYSIOLOGY	1 (1-0) F S
BO 660	(ZO 660) ADVANCED TOPICS IN ECOLOGY I	4 (3-3) S
BO 661	(ZO 661) ADVANCED TOPICS IN ECOLOGY II	4 (3-3) S
BO 691	BOTANY SEMINAR	1 (1-0) F S
BO 693	SPECIAL PROBLEMS IN BOTANY	Credits Arranged F S
BO 699	RESEARCH	Credits Arranged F S

## CHEMICAL ENGINEERING

### FOR UNDERGRADUATES

CHE 205	CHEMICAL PROCESS PRINCIPLES	3 (3-0) F S
Prerequisites: CH 107, MA 201		

The primary emphasis of the course is the chemical interactions of matter and the physical interactions of multiphase system. The course introduces engineering methods of treating material balances, stoichiometry, thermophysics, thermochemistry and first law thermodynamics.

Mr. Hopfenberg

CHE 225	CHEMICAL PROCESS SYSTEMS	3 (2-2) S
Prerequisite: PY 208		
Corequisite: MA 301		

Physical measurement of importance in chemical engineering. Temperature, pressure pH, concentration, etc. including dynamic response of measuring elements. Control element, electronic, pneumatic, etc. Introduction to Process Control.

Mr. Martin

CHE 300	CHEMICAL TECHNOLOGY AND THE ENVIRONMENT	3 (3-0) F
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The course is intended to provide a basis for informed judgment regarding appropriate political, economic, and technical means to prevent and control pollution. The emphasis is on chemical technology, both as a source of pollution and as a necessary means for pollution control. The course is intended for students with no background in engineering, but is open to all.

Mr. Hopfenberg

CHE 301, 302	ELEMENTS OF CHEMICAL ENGINEERING	3 (3-0) F S
Prerequisite: MA 212 (for CHE 301) CHE 301 (for CHE 302)		

An introduction to principles of chemical engineering including calculations involved in industrial processes and equipment. The course is designed for students not majoring in chemical engineering.

Mr. Bright

CHE 311	TRANSPORT PROCESSES I	3 (2-2) F S
Prerequisites: MA 301, PY 208, CHE 205		

An introduction to momentum, heat and mass transport processes, with emphasis on chemical engineering. Problems in fluid dynamics and heat transfer.

Mr. Rousseau

CHE 315	CHEMICAL PROCESS THERMODYNAMICS	3 (3-0) S
Prerequisites: CH 431, CHE 205, MA 301		

A study of the laws of thermodynamics and their application to chemical engineering problems, both in theory and in practice. Criteria of equilibrium in physical and chemical changes. Behavior of real fluids, including mixtures.

Mr. Beatty

CHE 316 THERMODYNAMICS OF CHEMICAL AND PHASE EQUILIBRIA 3 (3-0) S  
Prerequisite: CHE 315

Thermodynamics is the principal tool for systematic study of chemical reaction equilibria and phase equilibrium. The concepts of fugacity, activity, and chemical potential as methods, for predicting the effect of temperature, pressure, etc. on equilibrium compositions will be studied in considerable detail. Methods for measuring and estimating thermodynamic properties important to equilibrium calculation in real systems will be included. Mr. Beatty

CHE 325 INTRODUCTION TO PLASTICS 3 (3-0) F S  
Prerequisite: CH 103

A general survey of plastics and polymers. Emphasis is on types, applications, fabrication, processing and testing. Mr. Seely

CHE 327 SEPARATION PROCESSES I 3 (3-0) S  
Prerequisite: CHE 311

An application of the principles of transport phenomena to the unit operations of absorption, extraction, distillation, drying, filtration, etc. with emphasis on design procedures and economic consideration. Mr. Schoenborn

CHE 412 TRANSPORT PROCESSES II 3 (3-0) S  
Prerequisite: CHE 327

An intensive study of momentum, heat and mass transport processes, with emphasis on chemical engineering. Problems in fluid, heat and mass transfer. Mr. Ferrell

CHE 425 PROCESS MEASUREMENT AND CONTROL I 3 (2-2) F  
Prerequisites: CHE 225, CHE 327

A study of the continuous control of typical chemical engineering processes including the techniques of feedback, cascade, feedforward and interacting systems. Dynamics, stability, and control of heat exchangers, flow systems, distillation columns and chemical reactors are illustrated. Mr. Martin

CHE 426 PROCESS MEASUREMENT AND CONTROL II 3 (2-2) S  
Prerequisite: CHE 425 or EE 435 or MAE 435

An extension of the theory and application of process control techniques to the analysis of physical systems. This course covers sampled data and non linear systems and includes an introduction to optimum control techniques and adaptive control. Mr. Martin

CHE 428 SEPARATION PROCESSES II 3 (3-0) S  
Prerequisite: CHE 327

An intensive study of the principles (diffusion and interphase mass transfer) underlying such unit operations as distillation, drying, absorption, etc., with emphasis on procedures and economic problems. Mr. Schoenborn

CHE 431 CHEMICAL ENGINEERING LABORATORY I 3 (1-5) S  
Prerequisite: CHE 311

Laboratory work on typical apparatus involving unit operations. Experiments are designed to augment the theory and data of lecture courses and to develop proficiency in the writing of technical reports. Mr. Seely

CHE 432 CHEMICAL ENGINEERING LABORATORY II 3 (1-5) F  
Prerequisite: CHE 431

A continuation of CHE 431. This course will consist of a small number of group projects in research, design or development. Mr. Seely

**CHE 446 CHEMICAL PROCESS KINETICS** 3 (3-0) F  
 Prerequisite: CHE 315  
 A basic study of homogeneous and heterogeneous chemical reactions, and of catalysis. Mr. Stahel

**CHE 451 CHEMICAL ENGINEERING DESIGN** 3 (2-2) F S  
 Prerequisites: CHE 315, CHE 327, CHE 432  
 A general treatment of chemical process design and optimization. The interplay of economic and technical factors in process development, site selection, project design, construction and production management. Applications of cost accounting, cost estimation for new equipment, measures of profitability. Case studies, readings, design problems and reports. Mr. Marsland

**CHE 465 (BAE 465) INTRODUCTION TO BIOMEDICAL ENGINEERING** 3 (3-0) F  
 Prerequisites: MA 202 or MA 212, PY 212 or PY 221

An introduction to certain engineering concepts and to their quantitative application to biomedical problems such as flow in the cardiovascular and respiratory systems; transfer of thermal energy in and from warm-blooded animals; transport of materials through physiological tissues and membranes, and performance of organ replacement and assist devices such as the artificial kidney and the intra-aortic balloon. Mr. Beatty

**CHE 495 SEMINAR IN CHEMICAL ENGINEERING** 1 (1-0) F S  
 One semester required of seniors in chemical engineering.

Professional aspects of chemical engineering; topics of current interest in chemical engineering. Staff

**CHE 497 CHEMICAL ENGINEERING PROJECTS** 1-3 F S  
 Elective for seniors in chemical engineering.

Introduction to research through experimental, theoretical and literature studies of chemical engineering problems. Oral and written presentation of reports. Staff

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

**CHE 511 PROBLEM ANALYSIS FOR CHEMICAL ENGINEERS** 3 (3-0) S  
 Prerequisites: CHE 428, MA 301

The application of the methods of mathematical analysis to the formulation and solution of problems in transport phenomena, transient phenomena in unit operations, process dynamics and thermodynamics. Study and use of analog computer solutions of these problems. Mr. Ferrell

**CHE 513 THERMODYNAMICS I** 3 (3-0) F  
 Prerequisite: CHE 315

An intermediate course in thermodynamic principles and their application to chemical and phase equilibria. The course is largely from a macroscopic viewpoint, but consideration will be given to some aspects of the statistical viewpoint. Mr. Beatty

**CHE 515 TRANSPORT PHENOMENA** 3 (3-0) S  
 Prerequisite: CHE 327

A theoretical study of transport of momentum, energy and matter with emphasis on the latter two. The diffusional operations, including coupled heat and mass transfer, are introduced in the light of the theory. Mr. Marsland

**CHE 517 KINETICS AND CATALYSIS** 3 (3-0) F  
 Prerequisite: CHE 446

An intensive study of homogeneous and heterogeneous kinetic reactions. Empha-

sis will be placed on fundamental approaches, experimental methods and mathematical techniques in engineering analysis of chemical reaction systems.

Mr. Stahel

**CHE 521 MASS TRANSFER OPERATIONS**

3 (3-0) S

Prerequisite: CHE 327 or equivalent

Multicomponent mass transfer operations will be discussed in light of recent developments and innovations in both the operations themselves and in calculational techniques used in analyzing the operations. The equilibrium stage concept will be developed and as time permits, a discussion of the continuous rate processes will be undertaken. Problems unique to given operations, such as are encountered in extractive and azeotropic distillation will be discussed during the course.

Mr. Rousseau

**CHE 523 FLUID DYNAMICS AND HEAT TRANSFER**

3 (3-0) F

Prerequisite: CHE 311

Convective heat transfers in chemical process equipment, such as heat exchangers, chemical reactors, distillation and extraction reboilers, etc., and fluid dynamics and heat transfer of multiphase, multicomponent and chemically reactive systems.

Mr. Ferrell

**CHE 525 PROCESS DYNAMICS**

3 (3-0) F

Prerequisite: CHE 425

A detailed study of the dynamic response of typical chemical process equipment including instrumentation and process control devices. Fundamental concepts of automatic control of process variables such as temperature, pressure, flow and liquid level.

Mr. Martin

**CHE 527 (OR 527) OPTIMIZATION OF ENGINEERING PROCESSES**

3 (3-0) F

Prerequisite: MA 511, CSC 111 or equivalent

Mathematical methods for the optimization of engineering processes are developed, and illustrative applications of these methods are presented and discussed. Specific topics covered are drawn from a list which includes mathematical programming, geometric programming, sensitivity analysis, direct search and elimination techniques, variational techniques and the minimum principle, quasilinearization and dynamic programming. The emphasis throughout the course is on applications of the techniques discussed rather than fully rigorous development of the theory.

Mr. Felder

**CHE 535 ENGINEERING ECONOMY IN AIR POLLUTION CONTROL SYSTEMS**

3 (3-2) S

Prerequisites: MAE 409, CE 576, or equivalent first course

Principles and practice in designing equipment for the abatement of air pollution; estimation of capital cost and operating expense; economic optimization under various kinds of tax laws.

Mr. Marsland

**CHE 540 ELECTROCHEMICAL ENGINEERING**

3 (3-0) S

Prerequisite: Physical chemistry

The application of electrochemical principles to such topics as electrolysis, electroanalysis, electroplating, metal refining, etc.

Mr. Shoenborn

**CHE 541 CELLULOSE INDUSTRIES**

3 (3-0) F

Prerequisite: Organic chemistry

Methods of manufacture and application of cellulose chemical conversion products. Emphasis is placed on recent developments in the field of synthetic fibers, films, lacquers and other cellulose compounds.

Mr. Seely

CHE 543 TECHNOLOGY OF PLASTICS	3 (3-0) S
Prerequisite: Organic chemistry	
The properties, methods of manufacture and applications of synthetic resins. Recent developments in the field are stressed.	
	Mr. Schoenborn

CHE 561 BIOMEDICAL ENGINEERING I: FLUID FLOW AND HEAT TRANSFER	3 (3-0) S
Prerequisite: CHE 465 (BAE 465), or equivalent background	

The extension of fluid flow and heat transfer concepts to biomedical engineering is presented along with the grounding in physiology requisite to proper modeling of mammalian flow and thermal processes. Cardiovascular blood flow, pulmonary air flow and heat flow in temperature regulation are subjected to critical engineering analysis. Flows in the urinary, alimentary and lymphatic systems and in extra-corporeal assist devices including the heart-lung machine and artificial kidney are also studied.

Mr. Beatty

CHE 569 (TC 569) POLYMERS, SURFACTANTS AND COLLOIDAL MATERIALS	3 (3-0) F
Prerequisites: CHE 315, CH 431, CH 223	

A survey of the relationship between molecular structure and bulk properties of nonmetallic materials as applied in chemical engineering processes. Special attention will be directed to the application of surface and colloid chemistry as well as polymer science.

Mr. Hopfenberg

CHE 597 CHEMICAL ENGINEERING PROJECTS	1-3 F S
Prerequisite: Graduate standing	

A laboratory study of some phase of chemical engineering or allied field.

Staff

CHE 598 SPECIAL TOPICS IN CHEMICAL ENGINEERING	1-3 F S
Prerequisite: Graduate standing	

Study and investigation of special topics in chemical engineering. The course may consist of directed reading of the literature of chemical engineering, introduction to research methodology, special topics of current interest, seminar discussions dealing with special topics, etc.

Graduate Staff

## FOR GRADUATES ONLY

CHE 611 CHEMICAL PROCESS DESIGN AND SIMULATION	3 (3-0) S
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CHE 613 THERMODYNAMICS II	3 (3-0) F
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CHE 617 CHEMICAL REACTION ENGINEERING	3 (3-0) S
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CHE 621 ADVANCED MASS TRANSFER	3 (3-0) F
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CHE 623 ADVANCED FLUID DYNAMICS	3 (3-0) S
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CHE 624 ADVANCED HEAT TRANSFER	3 (3-0) F
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CHE 669 (TC 669) DIFFUSION IN POLYMERS	2 (2-0) S
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CHE 671 (TC 671) SPECIAL TOPICS IN POLYMER SCIENCE	1-3 F
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CHE 693 ADVANCED TOPICS IN CHEMICAL ENGINEERING	1-3 F S
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CHE 695 SEMINAR	1 (1-0) F S
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CHE 699 RESEARCH	Credits Arranged F S
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# CHEMISTRY

## FOR UNDERGRADUATES

### CHE 101 GENERAL CHEMISTRY I

4 (3-3) F S

Fundamental concepts in chemistry, including atomic and molecular structure, states of aggregation of matter, chemical reactions and stoichiometry. Should be followed by CH 103, CH 105 or CH 107.

### CH 103 GENERAL CHEMISTRY II

4 (3-3) F S

Prerequisite: CH 101

A continuation of CH 101, designed as a terminal course in chemistry and for students in curricula which do not require full-year chemistry courses beyond the freshman level. The major part of the course is devoted to descriptive inorganic, organic and nuclear chemistry.

### CH 104 EXPERIMENTAL CHEMISTRY

1 (0-3) F S

Corequisite: CH 105

A laboratory course to supplement the lecture course CH 105. Required for students who take CH 105 and who intend to take additional chemistry courses.

### CH 105 CHEMISTRY—PRINCIPLES AND APPLICATIONS

3 (3-0) F S

Prerequisite: CH 101

A continuation of CH 101, intended primarily for engineering students, with emphasis on introductory chemical thermodynamics, equilibrium, electrochemistry, chemical kinetics, and the application of basic chemical principles to the treatment of organic and inorganic systems. CH 105 will serve as a prerequisite for additional chemistry courses only if accompanied by CH 104.

### CH 106 LABORATORY TECHNIQUES I

1 (0-3) F

Corequisite: CH 101

Laboratory work to supplement the laboratory of CH 101.

### CH 107 PRINCIPLES OF CHEMISTRY

4 (3-3) F S

Prerequisite: CH 101 with a grade of C or better

A continuation of CH 101, designed for students who plan to take full-year courses in advanced chemistry and for any qualified student desiring a more quantitative course than CH 103. The major part of the course is devoted to the detailed quantitative aspects of stoichiometry, kinetics, equilibrium and electrochemistry, and the treatment of chemical reactions in terms of acid-base concepts.

### CH 108 LABORATORY TECHNIQUES II

1 (0-3) S

Corequisite: CH 107

Laboratory work to supplement the laboratory of CH 107, including some elementary quantitative analysis and inorganic preparations.

### CH 111 FOUNDATIONS OF CHEMISTRY

5 (5-0) F S

A one-semester course in general chemistry designed primarily for students in liberal arts. Topics include atomic and molecular structure, periodic classification, gas laws, chemical equilibrium, and elementary descriptive inorganic and organic chemistry.

### CH 220 INTRODUCTORY ORGANIC CHEMISTRY

4 (3-3) F S

Prerequisites: CH 103 or CH 107, or CH 104 and CH 105

An introduction to the fundamental principles of organic chemistry included in the study of the hydrocarbons, alcohols, ethers, aldehydes, ketones, acids and their

derivatives, esters, phenols, fats, carbohydrates, amino acids, proteins and a selected group of natural and synthetic products.

CH 221 ORGANIC CHEMISTRY I 4 (3-3) F S  
Prerequisite: CH 107

CH 221 and CH 223 cover the fundamentals of organic chemistry, including both aliphatic and aromatic compounds.

CH 223 ORGANIC CHEMISTRY II 4 (3-3) F S  
Prerequisite: CH 221

A continuation of CH 221.

CH 315 QUANTITATIVE ANALYSIS 4 (3-3) F S  
Prerequisites: CH 103 or CH 107, or CH 104 and CH 105

A one-semester course in volumetric and gravimetric analysis including techniques, stoichiometry and principles of neutralization, oxidation-reduction and precipitation methods.

CH 331 INTRODUCTORY PHYSICAL CHEMISTRY 4 (3-3) F S  
Prerequisites: CH 103 or CH 107, or CH 104 and CH 105; MA 102 or MA 112

Designed for students whose background in mathematics is not sufficient to meet the requirements of CH 431, CH 433, but who desire instruction on chemical principles in addition to that provided at the freshman level.

CH 401 SYSTEMATIC INORGANIC CHEMISTRY 3 (3-0) S  
Corequisite: CH 433

A survey of the chemical elements based on atomic structure and the periodic system, also introducing newer concepts of structure and symmetry. A knowledge of basic physical chemical principles is prerequisite.

CH 411 ANALYTICAL CHEMISTRY I 4 (2-6) F  
Prerequisites: CH 431, CH 434

An introduction to analytical chemistry, including the design, execution and interpretation of quantitative chemical measurements. Chromatographic, gravimetric and related techniques of separation are presented.

CH 413 ANALYTICAL CHEMISTRY II 4 (2-6) S  
Prerequisite: CH 411

Methods of quantitative analysis based on solution chemistry, electrochemistry and the interactions of radiation with matter. Specific topics include acid-base, potentiometric, and coulometric titrations, and absorption spectroscopy.

CH 428 QUALITATIVE ORGANIC ANALYSIS 3 (1-6) F S  
Prerequisite: CH 223

An introduction to the identification of organic compounds by means of physical properties (including infrared spectra), chemical classification tests and preparation of derivatives.

CH 431 PHYSICAL CHEMISTRY I 3 (3-0) F S  
Prerequisites: CH 107, MA 202, PY 203 or PY 208  
Corequisite: MA 301

CH 431, CH 433 and CH 435 provide an intensive study of physical chemical principles. CH 431 emphasizes states of matter, thermodynamics, and physical and chemical equilibrium.

CH 432 PHYSICAL CHEMISTRY I LABORATORY 1 (0-3) F  
Corequisite: CH 431

Laboratory course to accompany the lecture work in CH 431.

CH 433 PHYSICAL CHEMISTRY II 3 (3-0) F S  
Prerequisites: CH 431, MA 301

A continuation of CH 431, emphasizing properties of solids and solutions, electrochemistry, reaction kinetics and kinetic theory.

CH 434 PHYSICAL CHEMISTRY II LABORATORY 2 (0-6) S  
Corequisite: CH 433

A project-oriented course designed to acquaint chemistry students with the techniques of modern physical chemistry.

CH 435 PHYSICAL CHEMISTRY III 3 (3-0) F  
Prerequisites: CH 431, MA 301

A continuation of CH 431, emphasizing molecular structure and chemical bonding.

CH 441 COLLOID CHEMISTRY 3 (2-3) S  
Prerequisites: CH 220, CH 315

Adsorption, preparation, properties, constitution, stability and application of sols, gels, emulsions, foams and aerosols; dialysis; Dornan membrane equilibrium. (Offered spring 1973 and alternate years.)

CH 461 (TC 461) CHEMISTRY OF FIBERS 3 (3-0) F  
(See textile chemistry, page 467.)

CH 490 CHEMICAL PREPARATIONS 3 (1-6) F S  
Prerequisite: Three years of chemistry

Lectures and laboratory work in preparative chemistry. Synthetic procedures will be selected to illustrate advanced methods and techniques in both inorganic and organic chemistry.

CH 491 READING IN HONORS CHEMISTRY 2-6 F S  
Prerequisite: Three years of chemistry

A reading course for exceptionally able students at the senior level. The students will do extensive reading in areas of advanced chemistry and will present written reports of their findings.

CH 493 CHEMICAL LITERATURE 1 (1-0) F  
Prerequisite: Three years of chemistry

A systematic introduction to the location and retrieval of information required for the solution of chemical problems.

CH 495 SPECIAL TOPICS IN CHEMISTRY 1-3 F S  
Prerequisite: Permission of instructor

Designed to serve needs not covered by existing courses.

CH 499 SENIOR RESEARCH IN CHEMISTRY Arranged 1-3 F S  
Prerequisite: Three years of chemistry

An introduction to research. Independent investigation of a research problem under the supervision of a member of the chemistry faculty.

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

CH 501 INORGANIC CHEMISTRY I 3 (3-0) F  
Prerequisite: CH 433

Modern inorganic chemistry from the point of view of the chemical bond. Chemical periodicity and its origins in atomic structure, the ionic bond and electro-

negativity, crystal structure and bonding in ionic solids, the metallic state, conduction and semiconductors, and the preparation and properties of illustrative compounds.

CH 503 INORGANIC CHEMISTRY II

3 (3-0) S

Prerequisite: CH 501

The hydrogen molecule-ion and the theory of the covalent bond, molecular, orbitals and hybridization, dipole moments and magnetic properties, the theory of acids and bases, nonaqueous solvents, coordination compounds, carbonyl and quasi-aromatic compounds, and the chemistry of the transition metals, lanthanides and actinides.

CH 511 CHEMICAL SPECTROSCOPY

3 (3-0) F

Prerequisite: CH 433

Theory, analytical applications and interpretation of spectra as applied to chemical problems. Major emphasis will be placed upon ultraviolet, visible and infrared spectra.

CH 515 CHEMICAL INSTRUMENTATION

3 (3-0) S

Prerequisite: CH 431

Corequisite: CH 411

Basic electronic components and circuits, the response of laboratory instruments, design and modification of typical electronic control and measurement systems. Emphasis will be placed on the transducers and control elements utilized in chemical research. (Offered spring 1974 and alternate years.)

CH 521 ADVANCED ORGANIC CHEMISTRY I

3 (3-0) F

Prerequisites: CH 223, CH 433 or CH 435

Structure, stereochemistry and reactions of the various classes of hydrocarbons. The molecular orbital treatment of bonding and reactivity of alkenes, the conformational interpretation of cycloalkane and cycloalkene reactivity, and the application of optical isomerism to the study of reaction mechanisms will be emphasized.

CH 523 ADVANCED ORGANIC CHEMISTRY II

3 (3-0) S

Prerequisite: CH 521

An introduction to acid-base theory and mechanistic organic chemistry as applied to synthetically useful organic reactions.

CH 525 PHYSICAL METHODS IN ORGANIC CHEMISTRY

3 (3-0) S

Prerequisites: CH 223, CH 433 or CH 435

Application of physical methods to the solutions of structural problems in organic chemistry. Emphasis will be on spectral methods, including infrared, ultraviolet, nuclear magnetic resonance, mass spectrometry, electron paramagnetic resonance, X-ray and electron diffraction, and optical rotatory dispersion.

CH 531 CHEMICAL THERMODYNAMICS

3 (3-0) F

Prerequisites: CH 433, MA 301

An extension of elementary principles to the treatment of ideal and real gases, ideal solutions, electrolytic solutions, galvanic cells, surface systems, and irreversible processes. An introduction to statistical thermodynamics and the estimation of thermodynamic functions from spectroscopic data.

CH 533 CHEMICAL KINETICS

3 (3-0) S

Prerequisites: CH 433, MA 301

An intensive survey of the basic principles of chemical kinetics with emphasis on experimental and mathematical techniques, elements of the kinetic theory, and

theory of the transition state. Applications to gas reactions, reactions in solution, and mechanism studies.

CH 535 SURFACE PHENOMENA 3 (3-0) S  
Prerequisites: CH 433, MA 301

An intensive survey of the topics of current interest in surface phenomena. Formulations of basic theories are presented together with illustrations of their current applications. (Offered spring 1974 and alternate years.)

CH 537 QUANTUM CHEMISTRY 3 (3-0) S  
Prerequisites: MA 301, CH 435 or PY 407

The elements of wave mechanics applied to stationary energy states and time dependent phenomena. Applications of quantum theory to chemistry, particularly chemical bonds.

CH 545 RADIOCHEMISTRY 3 (2-3) S  
Prerequisite: CH 431 or PY 410

The applications of radioactivity to chemistry and the applications of chemistry to the radioactive elements, particularly the transuranium elements and fission products.

CH 562 (TC 562) PHYSICAL CHEMISTRY OF HIGH POLYMERS—  
BULK PROPERTIES 3 (3-0) F  
(See textile chemistry, page 467.)

## FOR GRADUATES ONLY

CH 623 VALENCE AND THE STRUCTURE OF ORGANIC MOLECULES 3 (3-0) F

CH 625 ORGANIC REACTION MECHANISMS 3 (3-0) S

CH 627 CHEMISTRY OF METAL-ORGANIC COMPOUNDS 3 (3-0) F

CH 631 CHEMICAL THERMODYNAMICS II 3 (3-0) S

CH 659 (BCH 659) NATURAL PRODUCTS 3 (3-0) F

CH 691 SEMINAR 1 (1-0) F S

CH 693 ADVANCED TOPICS IN PHYSICAL CHEMISTRY 3 (3-0) F S

CH 695 SPECIAL TOPICS IN CHEMISTRY Maximum 3 F S

CH 699 CHEMICAL RESEARCH Credits Arranged F S

## CIVIL ENGINEERING

### FOR UNDERGRADUATES

CE 201 ENGINEERING MEASUREMENTS IN SURVEYING 3 (2-3) F S  
Prerequisite: MA 201

Not for civil engineering or civil engineering-construction option students.

The general theory of engineering measurement, errors, significant figures, repeated observations, precision ratios and accuracy of measurements are presented. Other lecture topics include horizontal and vertical control, stadia theory, concepts of area measurements, elements of simple curves, photogrammetry and introduction to machine computation.

CE 202 INTRODUCTION TO CIVIL ENGINEERING 2 (1-3) F  
Prerequisite: MA 201

An introduction to civil engineering through the use of computers to solve typical problems in each subject area.

CE 301 ENGINEERING SURVEYING 3 (2-3) F  
Prerequisite: CE 202

The principles and applications of engineering surveying in solving civil engineering problems in planning, design and construction; including horizontal and vertical control; topographic maps, photogrammetry and elements of geodesy.

CE 305 TRANSPORTATION ENGINEERING I 4 (3-2) S  
Prerequisite: CE 301

An integrated approach to the planning, design and operation of transportation systems. Engineering and economic aspects of the basic transport modes, including highway, rail, water and air facilities, are investigated from the viewpoint of the civil engineer.

CE 325 STRUCTURAL ANALYSIS 3 (2-3) F  
Prerequisite: EM 301

Stress analysis of statically determinate beams and framed structures under fixed and moving loads; analysis of displacements by methods of conjugate beam and virtual work; indeterminate structural analysis of both rigid frames and trusses by virtual work and by stiffness method.

CE 326 STRUCTURAL ENGINEERING I 4 (3-3) S  
Prerequisite: CE 325

Fundamental principles of elastic, inelastic and ultimate strength analysis and proportioning of structural members in metal, concrete and timber.

CE 332 MATERIALS OF CONSTRUCTION 3 (2-3) F  
Prerequisite: MAT 200

Manufacture and properties of calcareous and bituminous cements and mineral aggregates. Mechanical properties of the following structural materials: Portland cement concrete, bituminous concrete, masonry materials and timber. Materials testing for research.

CE 342 SOIL ENGINEERING I 4 (3-2) S  
Prerequisite: CE 332

Soil properties and mechanics of analysis related to foundation investigations. Includes soil identification, index properties, effective stress concepts, settlement analysis, evaluation of shear strength and bearing capacity, and fundamentals of foundation selection and design.

CE 365 CONSTRUCTION ENGINEERING I 4 (3-3) S  
Prerequisite: Junior standing

A construction operations course with emphasis on the organization of the construction industry; construction methods, equipment, productivity and safety; project planning, scheduling and control.

CE 370 ELEMENTS OF ENVIRONMENTAL HYGIENE 3 (2-3) S  
Prerequisite: Sophomore standing

An introductory study of environmental factors affecting human health and their evaluation and control. Topics to be discussed include: water supplies; sewage disposal; swimming pool and refuse sanitation; insect and rodent control; milk and food sanitation; the physical factors of noise, heat, illumination, and ionizing radiation; housing; industrial hygiene; and environmental hygiene programs.

**CE 382 HYDRAULICS****4 (3-3) F S****Prerequisite:** EM 200

Properties of fluid, laws of conservation of mass, momentum and energy; applications to the mechanics of flow through pipes and channels; fluid measurements; theory of design and characteristics of hydraulic machines.

**CE 383 WATER RESOURCES ENGINEERING I****4 (3-3) S****Prerequisite:** CE 382

The study of the application of natural science, physics and chemistry in the engineering or urban water and waste systems. Case studies are utilized to illustrate the applications and the relationship of these systems to the management of environmental quality in urban areas.

**CE 406 TRANSPORTATION ENGINEERING II****3 (2-2) F****Prerequisite:** CE 305

An extension of Transportation Engineering I with particular emphasis on urban transportation problems and the actual design of modal interfaces such as airports, shopping centers, parking garages, port facilities and other multimodal terminals.

**CE 415 (ARC 415) ARCHITECTURAL STRUCTURES I****3 (2-3) F****Prerequisite:** EM 316 (ARC 316)

Not open to civil engineering students.

Fundamental concepts underlying the behavior of statically determinate building systems; investigation of the design and construction techniques used in steel and timber framing. Lectures will present concepts and methods; workshops will provide an opportunity for application and exploration of lecture material.

**CE 416 (ARC 416) ARCHITECTURAL STRUCTURES II****3 (2-3) S****Prerequisite:** CE 415 (ARC 415)

Not open to civil engineering students.

Fundamental concepts underlying the behavior, analysis, and design of statically indeterminate building systems; investigation of the design and construction techniques used in framing, analysis procedures for indeterminate structural elements; application of design with emphasis on reinforced concrete construction. A terminal design project provides an opportunity for a synthesis of the four semester structures sequence. Lectures will present concepts and methods; workshops will provide an opportunity for application and exploration of lecture material.

**CE 425 INTERMEDIATE STRUCTURAL ANALYSIS****3 (3-0) S****Prerequisite:** CE 325

A rigorous treatment, at intermediate level, of indeterminate structural analysis. Coverage includes energy principles, force and displacement methods and special topics.

**CE 427 STRUCTURAL ENGINEERING II****3 (2-3) F****Prerequisite:** CE 326

Basic concepts of structural design. Criteria for safety and serviceability. Structural connections. Analysis and design of complete structural systems.

**CE 443 SOIL ENGINEERING II****3 (3-0) F****Prerequisite:** CE 342

Lateral earth pressure theories and their application to analysis and design of slopes and retaining structures; ground water hydraulics; placement of fills; soil behavior in pavement systems, stabilization techniques.

- CE 450 CIVIL ENGINEERING DESIGN** 3 (1-6) S  
 Prerequisite: One from the following: CE 406, CE 427, CE 443 or CE 484  
 An integrated team approach is used to a major civil engineering project involving planning, design and analysis under realistic conditions including consideration of environmental factors.
- CE 460 CONSTRUCTION ENGINEERING PROJECT** 3 (2-3) S  
 Prerequisites: CE 463, CE 466  
 A study of the planning, design, construction and management of a construction project.
- CE 463 COST ANALYSIS AND CONTROL** 3 (2-3) F  
 Prerequisite: CE 365  
 Principles of cost engineering, project estimating, bid procedures, construction cost analysis and control.
- CE 464 LEGAL ASPECTS OF CONTRACTING** 3 (3-0) S  
 Prerequisite: Senior standing  
 Legal aspects of construction contract documents and specifications; owner-engineer-contractor relationships and responsibilities; bids and contract performance; labor laws.
- CE 466 CONSTRUCTION ENGINEERING II** 3 (2-3) F  
 Prerequisites: CE 326, CE 365  
 An introduction to construction of building systems, with emphasis on the planning, analysis, design and construction of structural subsystems.
- CE 472 ELEMENTS OF AIR QUALITY MANAGEMENT** 3 (2-3) S  
 Prerequisite: College level physics and senior standing  
 Pollution is studied from the standpoint of community air quality management. Topics to be discussed include: pollutant sources; effects on biological systems, materials, and the atmosphere; meteorological factors; air sampling; abatement and control techniques; air quality and emission standards; and legal, economic, and administrative aspects.
- CE 484 WATER RESOURCES ENGINEERING II** 3 (3-0) F  
 Prerequisite: CE 383  
 The study of the occurrence, flow and control of natural and impounded waters. Case studies of storm drainage, flood control and stream sanitation are utilized to illustrate the use of these principles in the management of river basin water resources.
- CE 487 (OY 487, MAS 487) PHYSICAL OCEANOGRAPHY** 3 (3-0) S  
 (See physical oceanography, page 420.)
- CE 498 SPECIAL PROBLEMS IN CIVIL ENGINEERING** 1-3 F S  
 Prerequisites: Senior standing in civil engineering or civil engineering-construction option  
 Study and investigation of special problems in some phase of civil engineering. The course may consist of directed reading in the literature of civil engineering, introduction to research methodology, seminar discussions, dealing with special civil engineering topics of current interest.

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

- CE 507 AIRPHOTO ANALYSIS I** 3 (2-3) F S  
Prerequisite: Senior standing  
Principles and concepts for engineering evaluation of aerial photographs, including analysis of soils and surface drainage characteristics.
- CE 508 AIRPHOTO ANALYSIS II** 3(2-3) S  
Prerequisite: CE 507  
Continuation of CE 507 with applications to highway and airport projects.
- CE 509 PHOTOGRAMMETRY** 3 (2-3) F  
Prerequisite: CE 201 or CE 301  
Elements of aerial photogrammetry as applied to civil engineering, surveying and mapping, geometry of aerial photographs, flight planning for aerial photography and stereoscopic plotter instruments, especially the Kelsh Plotter.
- CE 514 MUNICIPAL ENGINEERING PROJECTS** 3 (2-3) S  
Prerequisite: Senior standing in civil engineering  
Special problems relating to public works, public utilities, urban planning and city engineering.
- CE 515 TRANSPORTATION OPERATIONS** 3 (3-0) F  
Prerequisite: CE 305  
The analysis of traffic and transportation engineering operations.
- CE 516 TRANSPORTATION DESIGN** 3 (2-3) S  
Prerequisite: CE 305  
The geometric elements of traffic and transportation engineering design.
- CE 517 WATER TRANSPORTATION** 3 (3-0) F  
Prerequisite: CE 305  
The planning, design, construction and operation of waterways, ports, harbors and related facilities. Development of analytical techniques for evaluating the feasibility of piers, ports and multipurpose river basin projects. The design of marine structures and civil works that are significant in civil engineering, including locks, dams, harbors, ports and contractive and protective works.
- CE 524 ANALYSIS AND DESIGN OF MASONRY STRUCTURES** 3 (3-0) F  
Corequisite: CE 427  
Theory and design of masonry arches, culverts, dams, foundations and masonry walls subjected to lateral loads.
- CE 525 MATRIX STRUCTURAL ANALYSIS I** 3 (3-0) F  
Prerequisite: CE 425  
Matrix methods of structural analysis for digital computer solutions for general plane frames, trusses, and grids as well as general three dimensional trusses and frames. Inclusion of effects due to prestrain, temperature, elastic stability functions, joint deformations, and support settlements. Introduction to finite-element analysis of plane elasticity problems.
- CE 526 MATRIX STRUCTURAL ANALYSIS II** 3 (3-0) S  
Prerequisite: CE 326  
A study in depth of classical structural theories, including generalized stiffness and flexibility methods. Treatment of secondary stresses and highrise structures.

**CE 531 STRUCTURAL MODELS****3 (2-3) F****Prerequisite:** CE 427

Dimensional analysis and structural similitude, indirect and direct models, model materials and experimental techniques, individual project in structural model analysis.

**CE 534 PLASTIC ANALYSIS AND DESIGN****3 (3-0) S****Prerequisite:** CE 427

Theory of plastic behavior of steel structures; concept of design for ultimate load and the use of load factors. Analysis and design of components of steel frames including bracing and connections.

**CE 536 THEORY AND DESIGN OF PRESTRESSED CONCRETE****3 (3-0) F****Prerequisite:** CE 427

The principles and concepts of design in prestressed concrete including elastic and ultimate strength analyses for flexural, shear, bond and deflection. Principles of concordancy and linear transformation for indeterminate prestressed structures. Application of prestressing to tanks and shells.

**CE 541 (MAS 541, OY 541) GRAVITY WAVE THEORY I****3 (3-0) S**

(See marine sciences, page 373.)

**CE 544 FOUNDATION ENGINEERING****3 (3-0) S****Prerequisite:** CE 342

Subsoil investigations; excavations; design of sheeting and bracing systems; control of water; footing, grillage and pile foundations; caisson and cofferdam methods of construction.

**CE 547 FUNDAMENTALS OF SOIL MECHANICS****3 (3-0) F S****Prerequisite:** EM 301

Physical and mechanical properties of soils governing their use for engineering purposes; stress relations and applications to a variety of fundamental problems.

**CE 548 ENGINEERING PROPERTIES OF SOILS I****3 (2-3) F****Prerequisite:** CE 342

The study of soil properties that are significant in earthwork engineering, including properties of soil solids, basic physiochemical concepts, classification, identification, plasticity, permeability, capillarity, and stabilization. Laboratory work includes classification, permeability and compaction tests.

**CE 549 ENGINEERING PROPERTIES OF SOILS II****3 (2-3) S****Prerequisite:** CE 548

Continuation of CE 548, including the study of compressibility, stress-strain relations and shear strength theories for soil. Laboratory work includes consolidation and shear strength tests.

**CE 551 THEORY OF CONCRETE MIXTURES****3 (3-0) F****Prerequisite:** CE 332

Course work consists of study in depth of the theory of portland cement concrete mixtures including technology development and published research. Study includes types and properties of portland and special cements including chemical reactions; brief examination of history of mixture design; detailed study of current design methods including water-cement ratio, fineness modulus, B/Bo, American Concrete Institute, and Portland Cement Association procedures; properties of fresh and hardened concretes; strength-age-curing relationships, durability; admixtures; special concretes; production; and quality control.

**CE 553 ASPHALT AND BITUMINOUS MATERIALS****3 (2-3) F****Prerequisite:** CE 332

Course work consists of study in depth of properties of asphalts and tars for use in waterproofing and bituminous materials and study of the theories of design of bituminous mixtures for construction and paving uses. Study includes types and properties of asphalt cements, cutbacks, emulsions, blown asphalts and tars; brief examination of historical developments; detailed study of bituminous mixture design; properties of bituminous mixtures; and current research. Laboratory work includes standard tests on asphalts, tars, and road oils; design, manufacture and testing of trial batches; and current research techniques.

**CE 555 HIGHWAY AND AIRPORT PAVEMENT DESIGN****3 (2-3) S****Prerequisite:** CE 406 or CE 443

Theoretical analysis and design of highway airport pavements with critical evaluation of current design practices.

**CE 570 (BAE 570, MB 570) SANITARY MICROBIOLOGY****3 (2-3) S****Prerequisite:** MB 401 or equivalent

Fundamental aspects of microbiology and biochemistry are presented and related to problems of stream pollution, refuse disposal and biological treatment. Laboratory exercises present basic microbiological techniques and illustrate from a chemical viewpoint some of the basic microbial aspects of waste disposal.

**CE 571 THEORY OF WATER AND WASTE TREATMENT****3 (3-0) F****Prerequisite:** Graduate standing

Study of the physical, chemical and biological principles underlying water and waste treatment processes; including diffusion of gases, solubility, equilibrium and ionization, aerobic and anaerobic stabilization processes, sludge conditioning and disposal.

**CE 572 UNIT OPERATIONS AND PROCESSES IN WASTES ENGINEERING****3 (1-6) S****Prerequisite:** CE 571

Processes and operations in wastes engineering; including sedimentation, coagulation, filtration, adsorption, biological treatments, softening and new developments.

**CE 573 ANALYSIS OF WATER AND WASTES****3 (1-6) F****Corequisite:** CE 571

Chemical and physical analysis of water and wastes and interpretation of results.

**CE 574 (NE 574) ENVIRONMENTAL CONSEQUENCES OF NUCLEAR POWER****3 (3-0) S****Prerequisite:** Consent of instructor

In this course, the environmental consequences resulting from the siting, construction and operation of nuclear power plants are encountered. An understanding is sought of why more power plants are needed and of the environmental consequences of alternatives to nuclear power. Fuel sources; fuel reprocessing; sources and treatment of solid, liquid, gaseous wastes; the costs of minimizing wastes and the effects of rejected heat; beneficial uses of rejected heat; pertinent federal and state regulations are examined.

**CE 575 CIVIL ENGINEERING SYSTEMS****3 (3-0) S****Prerequisite:** MA 405

An examination of civil engineering systems and their design optimization. The systems to be studied include water resources engineering, structural engineering, transportation engineering and construction.

CE 576 ATMOSPHERIC POLLUTION 3 (3-0) S  
Prerequisite: Graduate or advanced undergraduate standing

A survey of the problem of atmospheric pollution. Topics to be discussed include: pollutant sources; effects on man and other animals, vegetation, materials and visibility; meteorological factors; air sampling, control devices; air quality and emission standards; and legal, economic and administrative aspects.

CE 578 (BAE 578) AGRICULTURAL WASTE MANAGEMENT 3 (2-3) F  
(See biological and agricultural engineering, page 261.)

CE 580 FLOW IN OPEN CHANNELS 3 (3-0) F S  
Prerequisite: CE 382

The theory and application of flow in open channels, including dimensional analysis, momentum-energy principle, gradually varied flow, high-velocity flow, energy dissipators, spillways, waves, channel transitions and model studies.

CE 581 (MAS 581) INTRODUCTION TO OCEANOGRAPHIC ENGINEERING 3 (3-0) F  
Prerequisite: CE 382

A rigorous treatment of the engineering aspects of physical oceanography. The theory for the propagation of waves, methods of wave forecasting and the analysis of wave spectra are presented. The applications of physical oceanography to the design of marine and coastal installations are shown.

CE 591, 592 CIVIL ENGINEERING SEMINAR 1 (1-0) F S  
Discussions and reports of subjects in civil engineering and allied fields.

CE 598 CIVIL ENGINEERING PROJECTS 1-6 F S  
Special projects in some phase of civil engineering.

## FOR GRADUATES ONLY

CE 601 TRANSPORTATION PLANNING 3 (3-0) S

CE 602 ADVANCED TRANSPORTATION DESIGN 3 (2-3) F

CE 603 AIRPORT PLANNING AND DESIGN 3 (2-3) F

CE 604 URBAN TRANSPORTATION PLANNING 3 (3-0) S

CE 605 TRAFFIC FLOW THEORY 3 (3-0) F

CE 624 ANALYSIS AND DESIGN OF STRUCTURAL SHELLS AND FOLDED PLATES 3 (3-0) S

CE 625 ADVANCED STRUCTURAL DESIGN I 3 (3-0) F S

CE 626 ADVANCED STRUCTURAL DESIGN II 3 (2-3) F S

CE 627 ANALYSIS AND DESIGN OF STRUCTURES FOR DYNAMIC LOADS 3 (3-0) S

CE 631 FIELD ANALYSIS OF STRUCTURAL SYSTEMS 3 (3-0) F

CE 635 ADVANCED THEORY OF CONCRETE STRUCTURES 3 (3-0) S

CE 641, 642 ADVANCED SOIL MECHANICS 3 (3-0) F S

CE 643 HYDRAULICS OF GROUND WATER 3 (3-0) F S

CE 644	GROUND WATER ENGINEERING	3 (3-0) F
CE 646	DYNAMICS OF SOILS AND FOUNDATIONS	3 (3-0) F
CE 651	THEORY OF LIMIT ANALYSIS	3 (3-0) F
CE 652	INELASTIC SOLIDS AND STRUCTURES	3 (3-0) S
CE 661	NUMERICAL METHODS IN STRUCTURAL MECHANICS	3 (3-0) F
CE 662	PROBABILISTIC METHODS OF STRUCTURAL ENGINEERING	3 (3-0) F
CE 671	ADVANCED WATER SUPPLY AND WASTE WATER DISPOSAL	4 (3-3) F
CE 672	ADVANCED WATER AND WASTES TREATMENT	4 (3-3) S
CE 673	INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL	3 (3-0) F S
CE 674	STREAM SANITATION	3 (3-0) F S
CE 698	SPECIAL TOPICS IN CIVIL ENGINEERING	1-3 F S
CE 699	CIVIL ENGINEERING RESEARCH	Credits Arranged

## COMPUTER SCIENCE

### FOR UNDERGRADUATES

CSC 101 INTRODUCTION TO PROGRAMMING 3 (3-1) F S

Understanding algorithms, programs, and computers. Organization and characteristics of computers. Introduction to fundamental algorithms associated with computing. Data representation. Basic programming and program structure. Debugging and verification of programs. Computer solution of numerical and nonnumerical problems using one or more programming languages.

CSC 111 ALGORITHMIC LANGUAGES I 2 (2-1) F S  
Corequisite: MA 102

Introduction to a problem-oriented computer language for use in problem solution using digital computers. This language currently is FORTRAN IV. This course is designed as a two-hour service course for scientifically oriented students, primarily for the School of Engineering. Programs to be written for this course will be slanted toward engineering applications.

CSC 112 BASIC COMPUTER ORGANIZATION AND ASSEMBLY LANGUAGE 3 (3-0) F S  
Prerequisite: CSC 101 or CSC 111

Binary and hexadecimal number systems. Description of machine organization, including memory, addressing schemes, registers, and data channels. Internal representation of data and instructions. Machine language and the assembly process. Loading and execution. Program relocation. Input and output using facilities of a supervisor program. Interrupts and their priorities. Combining separately translated programs for execution.

CSC 200 INTRODUCTION TO COMPUTERS AND THEIR USES 3 (3-0) F S  
A student who has previously taken CSC 101 or CSC 111 may not receive credit for this course.

An introduction to electronic digital computers, including the parts of a computer, a step-by-step description of the processes which the computer goes through in performing its tasks, and description of several uses to which the computer is currently being put. Intended for the non-technical student who desires a general appreciation of the capabilities of computers and their limitations.

**CSC 211 PROGRAMMING LANGUAGES**

3 (3-0) F S

Prerequisite: CSC 101 or CSC 111

An in-depth study of language features available in various languages. The student is expected to develop good programming habits by writing a variety of non-numerical application programs. Emphasis will be on the global properties of programs in block-structured languages, and list and string manipulation languages. Also data structure definition facilities, compile-time features and run-time representation of program and data structures will be compared in the languages studied.

**CSC 301 PRINCIPLES OF SYSTEMS PROGRAMS**

3 (3-0) F S

Prerequisite: CSC 112

Advanced topics in assembly language programming. Program relocatability. Definition, call and expansion of macros. Historical survey of development of operating systems. Definition of operating system components. Use of operating system facilities.

**CSC 302 INTRODUCTION TO NUMERICAL METHODS**

3 (3-0) F S

Prerequisite: CSC 101 or CSC 111

Corequisite: MA 301 or MA 312

Numerical computations with digital computers; floating point arithmetic and implications of round off error. Algorithms and computer techniques for the numerical solution of problems in several of the following areas: function evaluation; zeroes of functions; interpolation; numerical differentiation and integration; linear systems of equations; curve fitting; solutions of nonlinear equations; numerical solutions of ordinary differential equations.

**CSC 311 DATA STRUCTURES**

3 (3-0) F S

Prerequisite: CSC 112 and CSC 211

Corequisite: CSC 322

An introduction to data structures and the fundamental algorithms associated with their use. Topics to be considered are: Linear lists including stacks, queues and deques. Sequential and linked allocation of linear lists. Circular lists, doubly-linked lists, arrays and orthogonal lists. Trees including traversal of binary trees and binary representation of trees. Lists and garbage collection. Multilinked structures. Dynamic storage allocation. An introduction to searching and sorting techniques.

**CSC 312 COMPUTER ORGANIZATION AND LOGIC**

3 (3-0) F S

Prerequisite: CSC 322 or equivalent

Application of Boolean algebra to combinational circuit design problems. Sequential circuits. Organization and functional design of simplified computer components such as the memory unit, the arithmetic and logic unit and input-output devices. Architecture of computing systems. Functional characteristics of I/O devices, data channels, interrupt and priority systems. Microprogram control. Hardware-software tradeoffs and firmware.

**CSC 321 (E 321) COMPUTER GRAPHICS**

3 (2-2) S

(See engineering, general courses, page 318.)

**CSC 322 APPLIED ALGEBRAIC STRUCTURES**

3 (3-0) F S

Prerequisites: CSC 211, MA 231

Naive set theory, order and equivalence relations, functions, partitions, operations and congruences. Boolean algebra, semi-group, group and graph theory. Logic of propositions, first order predicate calculus, models for an axiomatic theory. Some applications and examples of these algebraic structures selected from formal language description, data structures, file organization, information retrieval, games, switching circuits, neural nets, sequential machines, artificial intelligence, syntactic structure of arithmetic expressions and theory of algorithms.

## FOR ADVANCED UNDERGRADUATES

CSC 411 INTRODUCTION TO SIMULATION 3 (3-0) F  
Prerequisite: MA 312 and ST 371 or equivalent

This course is designed to introduce simulation concepts and methodology to computer science students and students from other curricula. Modeling and computational techniques, Monte Carlo methods, and interactive simulation are discussed. Applications from the areas of interest of the students are used to illustrate the concepts presented in the lectures. In the laboratory, students will perform both analog and digital simulations and will be expected to complete an individual term project.

CSC 412 INTRODUCTION TO COMPUTABILITY, LANGUAGE AND AUTOMATA 3 (3-0) S  
Prerequisite: CSC 311 and CSC 322

Sequential machines as abstractions of digital computers described by state-transition graph. Sequential machines as language acceptors and as the finite control of a Turing Machine. Chomsky classification of languages and machines. Universal Turing machines and the halting problem. Church's thesis. Recursive functions. Discussion with heuristic argument that a function is recursive if and only if it is Turing computable. Discussion of the semi-group word problem and tree searching algorithm. Applications to artificial intelligence, perceptron simulation, game playing, syntactic analysis algorithms.

CSC 421 COMPUTER SYSTEMS FOR MANAGEMENT 3 (3-0) F  
Prerequisite: CSC 311

Introduction to management information systems (MIS) and scope of course. The data base approach. Characteristics of successful systems and dimensions of system evolution and evaluation. Models versus modeling in MIS design. A model of information flow and its economics. Profitability and risk analysis in corporate financial systems. Production/inventory control through MIS. Operations research techniques for MIS development. Management's MIS consultant. The general purpose MIS. Human factors in design and implementation of the new company MIS.

CSC 431 INFORMATION RETRIEVAL 3 (3-0) S  
Prerequisite: CSC 311

Organization and retrieval of information in natural language form. Analysis of information content by statistical, syntactic and logical methods. Automatic clustering and statistical association methods. Dictionary construction and utilization. File organization and retrieval techniques for text processing systems. Evaluation of retrieval effectiveness. Applications to both document retrieval and question answering systems.

CSC 432 INTRODUCTION TO DIGITAL SIGNAL PROCESSING 3 (2-2) S  
Prerequisites: CSC 302, ST 371 and MA 231 or MA 405

This course is an introduction to the use of digital computers in the processing of analog signals. The uses of operational amplifiers in SAH, DAC, and ADC's and other data acquisition devices are discussed. The discrete Fourier transform, digital filters and other algorithms used in processing time series are developed in the latter part of the course.

**CSC 462 COMPUTING FOR THE SOCIAL SCIENCES****3 (3-0) F**

Prerequisite: ST 311 or equivalent

A course designed to acquaint the social scientist with the information processing capabilities of a computer. Examples and problems drawn from the social sciences are used. An introduction to the following topics is included: Fortran, procedures for accessing statistical packages and other library routines, and data management using disks and tapes. (Computer science majors may not receive credit for CSC 462.)

**CSC 495 SPECIAL TOPICS IN COMPUTER SCIENCE****1-6 F S**

Prerequisite: Permission of instructor

This course is designed to serve needs not covered by existing courses. It will consist of one or more of the following types of study: readings in the literature of computer science, introductory research projects, major computer programming projects, seminars, or new course development. Work may be done in any area of computer science such as software, hardware utilization, programming languages, numerical methods or telecommunications.

**FOR GRADUATES AND ADVANCED UNDERGRADUATES****CSC 501 DESIGN OF SYSTEMS PROGRAMS****3 (3-0) F**

Prerequisite: CSC 301, CSC 311, CSC 312

Review of batch process systems programs, their components, operating characteristics, user services and their limitations. Implementation techniques for parallel processing of input-output and interrupt handling. Overall structure of multiprogramming systems on multi-processor hardware configurations. Details on addressing techniques, core management, file system design and management, system accounting, and other user-related services. Traffic control, interprocess communication, design of system modules, and interfaces. System updating, documentation and operation.

**CSC 502 COMPUTATIONAL LINGUISTICS****3 (3-0) F**

Prerequisite: Consent of instructor

Use of a symbol manipulation language (SNOBOL 4) in solving nonnumeric problems. Study of generative grammars, including finite-state, context-free, context-sensitive, and transformational grammars. Syntactic analysis by computers: algorithms and existing analysis systems for English. Computational semantics. Information retrieval and question-answering systems. This course is open to computer science students and those in other fields.

**CSC 504 APPLICATION OF LINGUISTIC TECHNIQUES TO COMPUTER PROBLEMS****3 (3-0) S**

Prerequisite: CSC 502

Semiotics and programming languages. Comparison of semantic theories. Representation, classification and interpretation of scenes and other multi-dimensional illustrations. Design of a formal language for describing 2-dimensional geometric figures, such as flow charts, chemical structures and logic diagrams. Characterization of programming languages according to the theory of transformational grammar.

**CSC 511 ARTIFICIAL INTELLIGENCE****3 (3-0) F**

Prerequisite: CSC 311

Definition of heuristic versus algorithmic methods, rationale of heuristic approach, description of cognitive processes. Objectives of work in artificial intelligence, simulation of cognitive behavior. Heuristic programming techniques. Survey of examples from representative application areas. The mind-brain problem and the nature of intelligence. Individual projects to illustrate basic concepts.

**CSC 512 METAPROGRAMS****3 (3-0) S****Prerequisite:** CSC 312 or consent of instructor

This course is intended to provide a detailed understanding of the techniques used in the design and implementation of compilers. Introduction to formal grammars and relations concerning a grammar. Detailed study of algorithms for lexical scanners, top-down recognizers, bottom-up recognizers for simple precedence grammars, operator precedence grammars, higher order precedence grammars, and bounded-context grammars. Runtime storage organization for a compiler including symbol tables, internal forms for source programs, semantic routines, error recovery and diagnostics, code generation and optimization, and interpreters.

**CSC 522 FORMAL LANGUAGES AND SYNTACTIC ANALYSIS****3 (3-0) F****Prerequisite:** CSC 211, CSC 311, CSC 512 (recommended)

Detailed study of formal languages and their relation to automata: languages and their representation, grammars, finite automata and regular grammars, context free grammars and pushdown automata, type O grammars and Turing machines, the Halting Problem, context-sensitive grammars and linear bounded automata, and operations on languages.

**CSC 527 (MA 527) NUMERICAL ANALYSIS I****3 (3-0) F S****Prerequisites:** CSC 101 or CSC 111; MA 301 or MA 312; MA 231 or MA 405

Theory of interpolation, numerical integration, iterative solution of non-linear equations, numerical integration of ordinary differential equations, matrix inversion and solution of simultaneous linear equations.

**CSC 528 (MA 528) NUMERICAL ANALYSIS II****3 (3-0) F S****Prerequisite:** CSC 527 (MA 527)

Least squares data approximation, expansions in terms of orthogonal functions, Gaussian quadrature, economization of series, minimax approximations, Padé approximations, eigenvalues of matrices.

**CSC 532 ARTIFICIAL INTELLIGENCE II****3 (3-0) S****Prerequisite:** CSC 511, course in mathematical logic

A rigorous approach to artificial intelligence emphasizing pattern recognition, theorem proving, game playing, learning and heuristic programming. Students will be assigned computer projects illustrating theoretical concepts introduced in lecture.

**CSC 595 SPECIAL TOPICS****1-6 F S****Prerequisite:** Consent of instructor

Topics of current interest in computer science not covered in existing courses.

**FOR GRADUATES ONLY****CSC 603 COMPUTATIONAL SEMANTICS****3 (3-0) F****CROP SCIENCE****FOR UNDERGRADUATES****CS 112 (SSC 112) PERSPECTIVES IN AGRONOMY****2 (0-5) S****Prerequisite:** Freshmen or sophomore standing and/or consent of instructor

An introductory course which presents the different facets of crops, soils, and agronomic production. Pertinent features of the materials used in agronomic production and the processing of agronomic products will be integrated into the

discussion to provide a better understanding of the relationship of agronomy to related fields. Presentation primarily through use of field trips and tours.

Mr. Long

**CS 211 CROP SCIENCE**

4 (4-0) F S

Prerequisite: BS 100

A study of fundamental morphological, physiological, and reproductive features of crop plants and the management practices which allow such plants to be produced economically.

Messrs. Emery, Fike

**CS 214 CROP SCIENCE LABORATORY**

1 (0-2) F S

Prerequisite or Corequisite: Any crop science course

Can be taken only once for credit.

The laboratory course will evaluate methods of identifying and dealing with the problems of growing and managing crop plants.

Messrs. Emery, Fike

**CS 311 FIELD CROP PRODUCTION**

3 (3-0) F

Prerequisites: CS 211, SSC 200, or consent of instructor

Crop characteristics and varieties, environmental factors, rotations, control of pests, and other production practices associated with the major cash crops of North Carolina and the United States.

Mr. Fike

**CS 312 PASTURES AND FORAGE CROPS**

3 (3-0) S

Prerequisite: BS 100, SSC 200 recommended

A study of the production and preservation of the principal forage crops. Special attention is given to the development and maintenance of pastures.

Mr. Chamblee

**CS 315 TURF MANAGEMENT**

3 (2-2) S

Prerequisite: BS 100

Basic principles of turf production and their practical application to establishment, maintenance, renovation, and pest control of lawns, playgrounds, sports fields, road areas, and similar specialized turf areas.

Mr. Gilbert

**CS 402 (BO 402) ECONOMIC BOTANY**

3 (2-3) S

Prerequisite: BO 200

Emphasis is on plants and human affairs, rather than taxonomy, production, or economics. Discussions center on all phases of the interrelationships of the plant world and the life history of incipient to modern human cultures. Treatment includes plants and plant products, beneficial and harmful, that man has used as necessities of life, as ameliorants contributing to his well-being, and as raw materials for industry. Ornamentals are excluded.

Mr. Timothy

**CS 411 ENVIRONMENTAL ASPECTS OF CROP PRODUCTION**

2 (2-0) F

Prerequisite: BO 421

The course is intended to be a study of the productivity and quality of crops in relation to all environmental factors, including man. Disorders caused by physical and biotic environmental stresses will be emphasized, and, to the extent current knowledge permits, the role of these environmental factors in normal crop development will be assessed and clarified. Considerable time will be spent discussing the utilization and manipulation of the environment for the continued improvement of crops.

Mr. Patterson

**CS 413 PLANT BREEDING**

2 (2-0) S

Prerequisite: GN 411

An appreciation course in plant breeding. Discussion topics include reproductive systems of higher plants; the genetic basis for plant improvement and the selection, evaluation, and utilization of crop varieties.

Mr. Emery

**CS 414 WEED SCIENCE****3 (2-2) F****Prerequisite:** CH 220 or equivalent

An introduction to weed science covering principles and practices involved in cultural and chemical weed control. The chemistry, properties and effects of herbicides on plants are covered. Identification of common weeds, principles and practices of herbicide applications and application equipment, and emphasis on proper use of herbicides are given in laboratory. An attempt is made to balance fundamental with practical information.

**Mr. Worsham****CS 490 SENIOR SEMINAR IN CROP SCIENCE****1 (1-0) S****Prerequisite:** Senior standing

The collection, organization, written preparation, and oral delivery of scientific information concerning topics of interest in crop science.

**Mr. Emery****FOR GRADUATES AND ADVANCED UNDERGRADUATES****CS 511 TOBACCO TECHNOLOGY****2 (2-0) S****Prerequisite:** CS 311, BO 421 or equivalent

A study of special problems concerned with the tobacco crop. The latest research problems and findings dealing with this important cash crop will be discussed.

**Mr. Collins****CS 513 PHYSIOLOGICAL ASPECTS OF CROP PRODUCTION****3 (3-0) S****Prerequisite:** BO 421

Discussion will emphasize pertinent physiological processes associated with crops and crop management such as plant growth, maturation, respiration and photoperiodism. Relationship of the environment to maximum crop yields will be discussed. (Offered spring 1974 and alternate years).

**Mr. Fike****CS 514 (HS 514) PRINCIPLES AND METHODS IN WEED SCIENCE****3 (2-2) S****Prerequisite:** CS 414 or equivalent

Studies on the losses caused by the ecology of weeds, biological control, basic concepts of weed management, herbicide-crop relationships and herbicide development. Introduction to greenhouse and bioassay techniques and field research techniques.

**Messrs. Monaco, Schrader****CS 541 (GN 541, HS 541) PLANT BREEDING METHODS****3 (3-0) F****Prerequisites:** GN 506, ST 511

An advanced study of methods of plant breeding as related to principles and concepts of inheritance.

**Messrs. Henderson, Wernsman****CS 542 (GN 542, HS 542) PLANT BREEDING FIELD PROCEDURES****2 (0-4) Sum.****Prerequisite:** CS 541 (GN 541, HS 541)

Laboratory and field study of the application of the various plant breeding techniques and methods used in the improvement of economic plants. (Offered summer 1974 and alternate years).

**Mr. Harvey****CS 545 (GN 545) ORIGIN AND EVOLUTION OF CULTIVATED PLANTS****2 (2-0) S****Prerequisite:** CS 541 or GN 540

Discussion topics include: mankind as a potential cultivator; man's anatomy, physiology and alimentary needs; origins of cultivation; spread of agriculture in terms of various theories; interactions of crops and environments with reference to crop evolution; special attributes of cultigens; modern aspects of evolution (breeding). (Offered spring 1974 and alternate years).

**Mr. Lee**

**CS 591 SPECIAL PROBLEMS**

Credits Arranged

Prerequisite: Consent of instructor

Special problems in various phases of crop science. Problems may be selected or will be assigned. Emphasis will be placed on review of recent and current research.

Graduate Staff

**FOR GRADUATES ONLY**

CS 613 (GN 613, HS 613) PLANT BREEDING THEORY 3 (3-0) S  
(Offered spring 1974 and alternate years.)

CS 614 (HS 614, SSC 614) HERBICIDE BEHAVIOR IN PLANTS AND SOILS 3 (3-0) F  
(Offered fall 1973 and alternate years.)

CS 690 SEMINAR 1 (1-0) F S

CS 699 RESEARCH Credits Arranged

**DESIGN**

DN 101, 102 ENVIRONMENTAL DESIGN I, II 3 (0-7) F S  
Prerequisites: (101) A major in the School of Design or consent of the dean; (102) DN 101

Investigation of the sensory environment as a design determinant. Emphasis is centered on individual discovery by the student who must function in problem-formulating and problem-solving processes. The course was designed to develop technical skills simultaneously with the development of conceptual models. Staff

DN 111, 112 PERCEPTION AND COMMUNICATION I, II 3 (0-7) F S  
Prerequisites: (111) A major in the School of Design or consent of the dean; (112) DN 111

Studies designed to increase perceptual awareness and communication skills through exercises in various communications media. Staff

DN 121, 122 HISTORY OF DESIGN I, II 3 (3-0) F S  
Prerequisite: (122) DN 121

A critical study of the related design fields from prehistoric periods to the modern era with reference to the social, political and technological movements which affected the development. Mr. Reuer

DN 201, 202 ENVIRONMENTAL DESIGN III, IV 4 (1-9) F S  
Prerequisites: (201) DN 102; (202) DN 201

An introduction to the disciplines of architecture, landscape architecture and product design through environmental studies and investigation of materials and processes. Emphasis is placed on organizing and solving design problems. Staff

DN 211, 212 VISUAL COMMUNICATION I, II 2 (0-6) F S  
Prerequisites: (211) DN 112; (212) DN 211

Visual communications processes as they support design activities. Two- and three-dimensional studies as related to conceptual and definitive aspects of the design process. Exercises are aimed at developing a mastery of both technical and nontechnical methods of visual communication. Staff

DN 311, 312 ADVANCED VISUAL LABORATORY I, II 2-4 F S  
Prerequisites: DN 111, DN 112, DN 211, DN 212

Extension of problems introduced in first- and second-year drawing on a more

advanced level. Problems will involve the human figure and its environment and investigate techniques to increase the ability of the student to express his ideas in varied forms. Staff

DN 411, 412 ADVANCED VISUAL LABORATORY III, IV 2-4 F S  
Prerequisites: DN 311, DN 312

Advanced problems in the fields of painting, sculpture, graphics and photography. Staff

DN 422 HISTORY OF DESIGN III 3 (3-0) F S  
Prerequisite: DN 122

Specialized historical studies in design fields. Staff

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

DN 505 INTRODUCTION TO DESIGN AS TASK 3 (0-6) F S Sum.  
Prerequisite: Graduate standing in design or permission of school dean

A studio course which approaches design primarily as task. A program of exercises will be undertaken to acquaint the student with the defining of tasks and their interpretation within a designer's power of action. Task as purpose or intention takes precedence over technique, which is considered as emergent from a defined task. Staff

DN 506 INTRODUCTION TO DESIGN AS TECHNIQUE 3 (0-6) F S Sum.  
Prerequisite: Graduate standing in design or permission of school dean

A studio course which approaches design primarily as technique. A program of exercises will be undertaken to acquaint the student with the techniques available to him and their relationship to existing and potential tasks. Technique as capability takes precedence over task, which is considered as emergent from a designated technique. Staff

DN 507 INTRODUCTION TO DESIGN AS PRACTICE 3 (3-0) F S Sum.  
Prerequisite: Graduate standing in design or permission of school dean

A seminar course intended to provide a comprehensive overview of current design concepts and activities. Presentations and discussions by School of Design faculty and design practitioners will explore the design fields in terms of issues, attitudes, methods and operations. Staff

DN 511, 512 ADVANCED VISUAL LABORATORY V, VI 2 (0-6) F S  
Prerequisite: Graduate standing

Advanced experimental studies in visual phenomena related to design. Staff

DN 541 SEMINAR ON IDEAS IN DESIGN 2 (2-0) F S  
Prerequisite: Graduate standing

An examination of aesthetics and the relationships of philosophic thought to design.

## FOR GRADUATES ONLY

DN 611, 612 ADVANCED VISUAL LABORATORY VII, VIII 2 (0-6) F S

# ECONOMICS

## FOR UNDERGRADUATES

### EC 205 ECONOMIC ACTIVITY 3 (3-0) F S

An introductory study of economic activity with emphasis on national economic problems.

### EC 206 THE PRICE SYSTEM 3 (3-0) F S

An introductory study of the determination of prices, wages, and value; analysis of the process and principles by which an economy allocates resources.

### EC 212 ECONOMICS OF AGRICULTURE 3 (3-0) F S Prerequisite: MA 111

An introduction to the economic principles underlying agricultural production and marketing; organization for production in agriculture; consumers and their influence upon the demand for agricultural products; relationships between agriculture and other segments of the economy; dynamic factors in the economy which affect agriculture.

### EC 260 ACCOUNTING I—CONCEPTS OF FINANCIAL REPORTING 3 (3-0) F S

A study of financial reporting concepts, the information generating process, income measurement, resource valuation, corporate equity measurement, reporting practices, and the interpretation and analysis of financial statements. Includes an introduction to internal controls, and merchandising and manufacturing inventories.

### EC 261 ACCOUNTING II—FINANCIAL INFORMATION SYSTEMS 3 (3-0) F S Prerequisite: EC 260

A study of information systems and their generation of financial data for reporting purposes. Includes consideration of the reporting practices related to non-corporate entities, financial statement structures and classifications, and internal controls.

### EC 262 MANAGERIAL USES OF COST DATA 3 (3-0) F S Prerequisite: EC 260

A study of the managerial uses of cost data in planning, controlling, and evaluating organizational activities and in making business decisions. Includes consideration of budgeting, cost behavior, product costing and pricing, and an introduction to production cost.

### EC 301 PRODUCTION AND PRICES 3 (3-0) F S Prerequisites: EC 206 or EC 212 and MA 112 or equivalent

An intensive study of the functioning of the market economy. An examination of the role of prices in determining the allocation of resources, the functioning of the firm in the economy, and forces governing the production of economic goods.

### EC 302 NATIONAL INCOME AND ECONOMIC WELFARE 3 (3-0) F S Prerequisites: EC 205 and MA 112 or equivalent

An intensive examination of factors determining the national income. The economic and social effects of the level, composition, and distribution of national income will be studied with reference to theories of economic welfare and to public policy.

### EC 303 FARM MANAGEMENT 3 (2-2) F S Prerequisite: EC 212

An application of basic economic principles and techniques to the problems facing

a farm business; use of budgeting, programming, systems analysis and other modern techniques to determine what, how, and how much to produce when faced with numerous alternatives; analysis of problems associated with farm size and the acquisition of adequate resources; use and analysis of farm records as an aid to better management. Two all-day Saturday field trips are required of all students.

**EC 310 ECONOMICS OF THE FIRM**

3 (3-0) F S

Prerequisite: EC 205 or EC 206 or EC 212

An examination of the economic setting within which the business firm makes decisions, and an application of economic analysis to these decisions; economics from the focal point of managerial decision making.

**EC 311 AGRICULTURAL MARKETS**

3 (3-0) S

Prerequisite: EC 212

A study of the agricultural marketing system and the current economic forces affecting its structure and efficiency; decision making by agricultural business firms, with some discussion of integration and interfirm relationships; effects of monopoly in marketing relative to government policies of control. Classroom discussion is supplemented by visits to marketing firms and by practical problems illustrating firm decisions. A laboratory period will be included in alternate weeks beginning with the second full week of classes. Students are expected to examine individually the marketing problems associated with the commodity of their choice.

**EC 317 INTRODUCTION TO METHODS OF ECONOMIC ANALYSIS**

3 (3-0) F S

Prerequisite: EC 301

This course treats the fundamentals of quantitative methods and economic models in the application to economic and industrial problems. Through the study of economic variables and their parameters it lays the groundwork for later study of firm and consumer behavior. Analysis of the supply and demand sides of the market equation is emphasized. There is further examination of the economic structure from the standpoint of multiple markets and the general economy.

**EC 360 FINANCIAL REPORTING THEORY AND PRACTICE I**

3 (3-0) F

Prerequisite: EC 261

A study of the theory and practice of financial reporting, the preparation of working papers and financial statements, the valuation and reporting problems relating to cash, receivables, inventories, investments, and tangible and intangible assets. Includes consideration of related professional pronouncements.

**EC 361 FINANCIAL REPORTING THEORY AND PRACTICE II**

3 (3-0) S

Prerequisite: EC 360

A study of the theory and practice of financial reporting, the valuation and reporting problems relating to current and non-current liabilities, and corporate and non-corporate owners' equities. Includes consideration of cash and fund-flow reporting, the analysis of financial statements, the impact of price-level changes on financial reporting, and professional literature.

**EC 362 PRODUCTION COST ANALYSIS AND CONTROL**

3 (3-0) F

Prerequisite: EC 262

A study of cost analysis and control, and managerial reporting practices for producing activities, the development and use of cost standards and budgets, and the cost measurement of productive inputs for units of productive outputs. Managerial use of cost data in analyzing, planning, and controlling business activity is emphasized. Includes consideration of information systems and internal controls.

**EC 370 (HI 370) THE RISE OF INDUSTRIALISM**

3 (3-0) F

Prerequisites: EC 206 and HI 102

The pattern of historical development of modern industrial economy is studied. Origins in 16th century England, the origins of capitalism are related to succeeding developments there in the overseas colonial empire and in the remainder of the areas influenced by that development.

**EC 401 ECONOMIC ANALYSIS FOR NONMAJORS**

**3 (3-0) F S**

Prerequisite: EC 205

An intensive treatment of intermediate economic theory of firm, household and market behavior primarily for graduate students desiring a minor in economics at the master's level. Students with an adequate background in economics and mathematics will elect EC 501 rather than EC 401. Topics include demand, production and cost theory, market equilibrium under competitive and non-competitive conditions, and introduction to input-output and general equilibrium theory, the spatial arrangement of economic activity and problems of economic efficiency.

**EC 402 FINANCIAL INSTITUTIONS**

**3 (3-0) F S**

Prerequisite: EC 302

An examination of the flow-of-funds among the principal financial institutions in the American economy; the behavior of the money and capital markets; and the allocation of savings flows into investment expenditures.

**EC 407 BUSINESS LAW I**

**3 (3-0) F S**

Prerequisites: EC 205, EC 206 or EC 212

A course dealing with elementary legal concepts, contracts, agency, negotiable instruments, sales of personal property and insurance. Uniform commercial code considered under all titles applicable.

**EC 408 BUSINESS LAW II**

**3 (3-0) F S**

Prerequisite: EC 407

Deals with real property, bailments, partnerships, corporations, chattel mortgages, mortgages on real estate, landlord and tenant, insurance, wills, suretyship, conditional sales and bankruptcy. Uniform commercial code considered under all titles applicable.

**EC 410 PUBLIC FINANCE AND FISCAL POLICY**

**3 (3-0) F**

Prerequisites: EC 205, EC 206 (EC 301 recommended)

An analysis of the economic effects of government taxation and expenditure decisions. Major attention will be given to current tax policy issues both at the federal level and at the state-local level. A description of different types of budgets and the effect of budgetary policy upon the level of economic activity will also be included.

**EC 411 MARKETING METHODS**

**3 (3-0) F S**

Prerequisite: EC 205, EC 206 or EC 212

Marketing institutions and their functions and agencies; retailing, market analysis; problems in marketing.

**EC 413 COMPETITION, MONOPOLY AND PUBLIC POLICY**

**3 (3-0) F S**

Prerequisite: EC 301 recommended but not required

An analysis of the effect of modern industrial structure on competitive behavior and performance, in the light of contemporary price theory and the theory of workable competition; a critical evaluation of the legislative content, judicial interpretation and economic effects of the antitrust laws.

**EC 415 FARM APPRAISAL AND FINANCE**

**3 (2-3) F**

Prerequisite: EC 303

Examination of the source of the productivity and value of farm inputs; a critical

analysis of and practice in the use of farm appraisal procedures currently used for land and buildings; review of the sources of and repayment practices used in short and intermediate credit in agriculture; consideration of the forces operating in the whole economy with an examination of the implications of these changes for both the lender and borrower in agriculture.

**EC 420 CORPORATION FINANCE**

**3 (3-0) F S**

Prerequisites: EC 205, EC 260

Financial instruments and capital structure; procuring funds, managing working capital; managing corporate capitalization; financial institutions and their work.

**EC 422 INVESTMENTS AND PORTFOLIO MANAGEMENT**

**3 (3-0) F S**

Prerequisites: EC 205, ST 311

An analysis of the problems in the investment process, which is dichotomized into security analysis and portfolio management with emphasis on the latter. The approach is to explain briefly what the traditional thinking has been, and to examine closely the modern revolution in investments which emphasizes a quantitative framework to achieve the goal of performance. After describing what an individual investor faces in making decisions, the question of professional management as an alternative is viewed critically.

**EC 425 INDUSTRIAL MANAGEMENT**

**3 (3-0) F S**

Prerequisite: Junior standing

Principles and techniques of modern scientific management; relation of finance, marketing, industrial relations, accounting and statistics to production planning and control; analysis of economic, political and social influences on production.

**EC 426 PERSONNEL MANAGEMENT**

**3 (3-0) F S**

Prerequisite: Junior standing

The scientific management of manpower, from the viewpoint of the supervisor and the personnel specialists; a study of personnel policy and a review of the scientific techniques regarding the specific problems of employment, training, promotion, transfer, health and safety, employee service and joint relations.

**EC 430 AGRICULTURE PRICE ANALYSIS**

**3 (3-0) F**

Prerequisite: EC 311

Principles of price formation; the role of price in the determination of economic activity; the interaction of cash and future prices for agricultural commodities; methods of price analysis, construction of index numbers, analysis of time series data including the estimation of trend and seasonal variations in prices.

**EC 431 LABOR ECONOMICS**

**3 (3-0) F S**

Prerequisite: EC 301 recommended but not required

An economic approach to the labor market and to labor market problems including unemployment and the determination of wages, hours and working conditions under various labor market structures; an examination of the economic effects of trade unions and an introduction to the theory of human capital.

**EC 432 INDUSTRIAL RELATIONS**

**3 (3-0) F S**

Prerequisite: EC 205 or EC 212

Collective bargaining; analysis of basic labor law and its interpretation by the courts and governmental agencies; an examination of specific terms of labor contracts and their implications for labor and management; an examination of labor objectives and tactics and management objectives and tactics; problems of operating under the labor contract.

**EC 440 ECONOMIC DEVELOPMENT****3 (3-0) S****Prerequisite:** EC 302

An examination of the institutional background required for national economic development. The conditions apparent for past growth of nations are compared with conditions obtained in presently retarded nations. Conclusions are drawn from this comparison to provide an introduction to the theoretical models of growth.

**EC 441 AGRICULTURAL DEVELOPMENT IN FOREIGN COUNTRIES****3 (3-0) S****Prerequisite:** EC 205 or EC 206 or EC 212

Identification of agricultural problems in underdeveloped countries; a review of economic criteria for analyzing the problems of developing agriculture and the techniques of analysis for solving such problems. Case studies of development programs in various countries will be discussed.

**EC 442 EVOLUTION OF ECONOMIC IDEAS****3 (3-0) S****Prerequisite:** EC 301

An analysis of the development of economic thought and method during the past two centuries; economics as a cumulative body of knowledge in a context of emerging technology, changing institutions, pressing new problems and the growth of science.

**EC 448 INTERNATIONAL ECONOMICS****3 (3-0) F****Prerequisites:** EC 205 and EC 206 or EC 212

A study of international economics, including trade, investment, monetary relations and certain aspects of economic development; emphasis upon analytical and policy approaches, although some institutional material is included.

**EC 451 INTRODUCTION TO ECONOMETRICS****3 (3-0) F S****Prerequisites:** EC 301, EC 302 and EC 317 or ST 311

An introduction to the measurement, specification, estimation and interpretation of functional relationships through single equation least-square techniques. Simple and multiple regression, curvilinear regression and various transformations will be used to measure: demand, cost, production, consumption and investment relationships.

**EC 460 SPECIALIZED FINANCIAL REPORTING THEORY AND PRACTICE****3 (3-0) F****Prerequisite:** EC 361

A study of the specialized valuation and reporting problems relating to consolidated financial statements, business combinations and reorganizations, governmental and nonprofit organizations, home office and branch relationships, foreign affiliates, estates and trusts, and business firms experiencing financial difficulties. Includes a study of related professional publications.

**EC 464 INCOME TAXATION****3 (3-0) F S****Prerequisite:** EC 260

A study of federal and state income tax laws relating to individuals and other taxable or reporting entities, the measurement and reporting of taxable income, and basic research in taxation. Includes an introduction to tax planning.

**EC 466 EXAMINATION OF FINANCIAL STATEMENTS****3 (3-0) S****Prerequisite:** EC 361

A study of the objectives, standards, procedures, problems, practices and theory of financial statement examination as performed by independent public accountants, the professional standards and ethical codes, the features of information systems and internal control, and other professional topics. Includes extensive use of professional literature and authoritative pronouncements.

EC 468 PROFESSIONAL ACCOUNTANCY RÉSUMÉ  
Prerequisites: EC 362 and EC 460

3 (3-0) S

A review and summation of the theory and practice of financial reporting and professional accountancy, as they relate to preparation for the certified public accountant's examination, covering both their general and specialized topics.

EC 470 (HI 470) EVOLUTION OF THE AMERICAN ECONOMY

3 (3-0) S

Prerequisites: EC 206 and HI 243 or HI 244 or HI 448 or HI 452

The continuing advances of modern industrialization are related to the development of the American nation. Contemporary problems and issues are analyzed with reference to their origins in the historical growth of the economy.

EC 475 COMPARATIVE ECONOMIC SYSTEMS

3 (3-0) F

Prerequisite: EC 205 or EC 206

A general study of different economic systems. Concentration will be given to capitalist or market economies and these will be contrasted with collectivist types of systems. Emphasis will be given to the Soviet economy.

EC 482 (TX 482) SALES MANAGEMENT FOR TEXTILES

3 (3-0) S

(See textile technology, page 471.)

EC 490, 491 SENIOR SEMINARS IN ECONOMICS

3 (3-0) F S

Prerequisites: EC 301, EC 302

The terminal courses in undergraduate study of economics. The student is assisted in summarizing his training, and in improving his capacity to recognize problems and to select logically consistent means of solving problems. This is done on a small-group and individual basis.

EC 494, 495 (PS 494, 495; SOC 494, 495) URBAN SEMINAR

3 (3-0) F S

Prerequisite: Junior standing

A study of urban and urban-related problems through theories from the disciplines of politics, sociology and economics, and their application to an existing environment. Intermixed with formal study will be field research in various local communities. In addition, students will be involved with both public and private agencies and with local leaders in ongoing programs in Raleigh and adjacent communities.

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

EC 501 PRICE THEORY

3 (3-0) F S

Prerequisites: EC 301 and MA 112 or equivalent

An intensive analysis of the determination of prices and of market behavior, including demand, cost and production, pricing under competitive conditions and pricing under monopoly and other imperfectly competitive conditions.

EC 502 INCOME AND EMPLOYMENT THEORY

3 (3-0) F S

Prerequisite: EC 302

A study of the methods and concepts of national income analysis with particular reference to the role of fiscal and monetary policy in maintaining full employment without inflation.

EC 510 (PS 510) PUBLIC FINANCE

3 (3-0) F

Prerequisite: EC 205

A survey of the theories and practices of governmental taxing, spending and borrowing, including intergovernment relationships and administrative practices and problems.

**EC 515 WATER RESOURCES ECONOMICS****3 (3-0) S****Prerequisite:** Graduate standing

The application of economic principles in the allocation of water resources. Attention is given especially to the basic issues of how to effect maximum economic efficiency in the use of a resource that is no longer a free good, under the consideration of the goals of the public and private sectors of the enterprise economy. Both economic and political consequences of decision making are studied.

**EC 521 MARKETS AND TRADE****3 (3-0) F****Prerequisite:** EC 301

This course emphasizes the space, form and time dimensions of market price and the location and product combination decisions of firms. Consideration is given to the ways in which non-price factors and public-policy choices influence firm behavior and the efficiency of marketing systems. Application of these models to agricultural, industrial and public-service questions is emphasized, including the relationships between resource availability and the spatial arrangement of economic activity.

**EC 523 PLANNING FARM AND AREA ADJUSTMENTS****3 (2-2) S****Prerequisite:** EC 303

The application of economic principles in the solution of production problems on typical farms in the state; methods and techniques of economic analysis of the farm business; application of research findings to production decisions; development of area agricultural programs.

**EC 525 MANAGEMENT POLICY AND DECISION MAKING****3 (3-0) F S****Prerequisite:** EC 301

A review and consideration of modern management processes used in making top-level policies and decisions; an evaluation of economic, social and institutional pressures, and of the economic and noneconomic motivations, which impinge upon the individual and the organization. The problem of coordinating the objectives and the mechanics of management is examined.

**EC 533 AGRICULTURAL POLICY****3 (3-0) S****Prerequisite:** EC 301

A review of the agricultural policy and action programs of the federal government as regards both input supply and commodities, analysis of objectives, principal means and observable results as regards resource use and income distribution within agriculture, and between agriculture and the rest of the economy; appraisal of the effects alternative policy proposals would have on domestic and foreign consumption.

**EC 535 SOCIAL SCIENCE CONCEPTS IN MANAGERIAL PROCESSES****3 (3-0) S****Prerequisite:** Six hours in economics

Interrelationships between concepts from economics and from other social sciences in managerial processes of clarifying goals, discovering alternatives and choosing courses of action. Cases are used to provide opportunities to compare contributions of theoretical concepts from economics, political science, social psychology, sociology and management science to managerial processes. Theoretical concepts are drawn from readings in the various disciplines.

**EC 550 MATHEMATICAL MODELS IN ECONOMICS****3 (3-0) S****Prerequisites:** EC 301, EC 302, MA 212 and MA 405 recommended but not required

An introductory study of economic models emphasizing their formal properties. The theory of individual economic units is presented as a special case in the theory of inductive behavior. Mathematical discussions of the theory of the consumer, the theory of the firm and welfare economics will show the relevance of such topics as

constrained maxima and minima, set theory, partially and simply ordered systems, probability theory and game theory to economics.

**EC 551 AGRICULTURAL PRODUCTION ECONOMICS**

**3 (3-0) F**

Prerequisite: EC 301

An economic analysis of agricultural production including: production functions, cost functions, programming and decision-making principles; and the applications of these principles to farm and regional resources allocation, and to the distribution of income to and within agriculture.

**EC 555 LINEAR PROGRAMMING**

**3 (3-0) F S**

Prerequisites: EC 301, MA 212, MA 405

Recent developments in the theory of production, allocation and organization; optimal combination of integrated productive processes within the firm; applications in the economics of industry and of agriculture.

**EC 561 (ST 561) INTERMEDIATE ECONOMETRICS**

**3 (3-0) S**

Prerequisites: EC 501 and ST 501 or MA 112

The formalization of economic hypotheses into testable relationships and the application of appropriate statistical techniques will be emphasized. Major attention will be given to procedures applicable for single equation stochastic models expressing microeconomic and macroeconomic relationships. Statistical considerations that are relevant in working with time series and cross-sectional data in economic investigations will be covered. The use of simultaneous equation models and the available estimation techniques will be surveyed.

**EC 570 ANALYSIS OF AMERICAN ECONOMIC HISTORY**

**3 (3-0) F**

Prerequisite: EC 470 (HI 470) or graduate standing

Stresses the application of economic analysis to the formulation and testing of hypotheses concerning economic growth and development in the historical context. Problems selected for analysis will be drawn primarily from American economic history.

**EC 574 (SOC 574) THE ECONOMICS OF POPULATION**

**3 (3-0) F S**

Prerequisite: EC 301

A review of pre-Malthusian thought up to contemporary population theories. The student is introduced to data sources, statistical tools and methodology for economic analysis in demography. There follows an intensive treatment of microeconomic models of fertility. On the macroeconomic side, economic demographic models are examined. Implications of these economic models for public policy are developed. Underpopulation, overpopulation, optimum growth rate and incentive schemes are discussed.

**EC 585 (TX 585) MARKET RESEARCH IN TEXTILES**

**3 (3-0) S**

(See textile technology, page 472.)

**EC 590 SPECIAL ECONOMICS TOPICS**

**Maximum 6**

Prerequisite: Consent of instructor

An examination of current problems in economics organized on a lecture-discussion basis. The content of the course will vary as changing conditions require the use of new approaches to deal with emerging problems.

**EC 598 TOPICAL PROBLEMS IN ECONOMICS**

**1-6**

Prerequisite: Consent of instructor

An investigation of topics of particular interest to advanced students under the direction of faculty members on a tutorial basis. Credits and content will vary with the needs of the students.

## FOR GRADUATES ONLY

EC 600	ADVANCED PRICE THEORY	3 (3-0) F S
EC 601	PRICES, VALUE AND WELFARE	3 (3-0) F S
EC 602	ADVANCED INCOME AND EMPLOYMENT THEORY	3 (3-0) F S
EC 603	HISTORY OF ECONOMIC THOUGHT	3 (3-0) F S
EC 604	MONETARY ECONOMICS	3 (3-0) F
EC 606	INDUSTRIAL ORGANIZATION AND CONTROL	3 (3-0) F
EC 610	THEORY OF PUBLIC FINANCE	3 (3-0) F S
EC 625	LONG RANGE PLANNING IN BUSINESS AND INDUSTRY	3 (3-0) S
EC 630	LABOR ECONOMICS AND MANPOWER PROBLEMS	3 (3-0) S
EC 631	HUMAN CAPITAL	3 (3-0) F
EC 632	ECONOMIC WELFARE AND PUBLIC POLICY	3 (3-0) S
EC 640	ANALYSIS OF ECONOMIC DEVELOPMENT	3 (3-0) S
EC 641	AGRICULTURAL PRODUCTION AND SUPPLY	3 (3-0) S
EC 642	CONSUMPTION, DEMAND AND MARKET INTERDEPENDENCY	3 (3-0) F
EC 645	PLANNING PROGRAMS FOR ECONOMIC DEVELOPMENT	3 (3-0) F S
EC 648	THEORY OF INTERNATIONAL TRADE	3 (3-0) S
EC 649	MONETARY ASPECTS OF INTERNATIONAL TRADE	3 (3-0) S
EC 650	ECONOMIC DECISION THEORY	3 (3-0) F S
EC 651	(ST 651) ECONOMETRICS	3 (3-0) F
EC 652	(ST 652) TOPICS IN ECONOMETRICS	3 (3-0) S
EC 665	ECONOMIC BEHAVIOR OF THE ORGANIZATION	3 (3-0) F S
EC 699	RESEARCH IN ECONOMICS	Credits Arranged

## EDUCATION

### FOR UNDERGRADUATES

ED 100	INTRODUCTION TO INDUSTRIAL EDUCATION (See industrial and technical education, page 359.)	2 (2-0) F
ED 101	ORIENTATION (See mathematics and science education, page 386.)	0 (1-0) F

ED 102 OBJECTIVES IN AGRICULTURAL EDUCATION (See agricultural education, page 248.)	1 (1-0) F S
ED 203 INTRODUCTION TO TEACHING MATHEMATICS AND SCIENCE (See mathematics and science education, page 386.)	3 (2-3) F S
ED 304 (PHI 304) PHILOSOPHY OF EDUCATION (See philosophy, page 414.)	3 (3-0) F S
ED 305 ANALYSIS OF TECHNICAL EDUCATION PROGRAMS AND COURSE CONSTRUCTION (See industrial and technical education, page 359.)	3 (3-0) S
ED 313 CONTEMPORARY VOCATIONAL AGRICULTURE (See agricultural education, page 248.)	3 (3-0) F S
ED 318 (SOC 318) EDUCATIONAL SOCIOLOGY (See sociology, page 451.)	3 (3-0) F S
ED 327 HISTORY AND PHILOSOPHY OF INDUSTRIAL AND TECHNICAL EDUCATION (See industrial and technical education, page 359.)	3 (3-0) F
ED 344 SECONDARY EDUCATION Prerequisite: Junior standing	3 (3-0) F S
An overview of secondary education, including development, problems, services, trends, teaching profession, role of school in the community; purposes and objectives; the development and status of secondary education in North Carolina. Mr. Ivie, Miss Weck	
ED 405 INDUSTRIAL AND TECHNICAL EDUCATION SHOP AND LABORATORY PLANNING (See industrial and technical education, page 359.)	3 (3-0) F
ED 410 DRIVER EDUCATION	3 (2-2) S Sum.
The principles of teaching basic driving skills, including the new concept of defensive driving, observance and interpretation of motor vehicle laws, adverse driving conditions, handling of accident situations and care of the car. Staff	
ED 411 STUDENT TEACHING IN AGRICULTURE (See agriculture education, page 248.)	8 (2-15) F
ED 412 TEACHING ADULTS (See agricultural education, page 248.)	2 (1-2) F S
ED 413 PLANNING EDUCATIONAL PROGRAMS (See agricultural education, page 248.)	2 (1-2) F S
ED 420 PRINCIPLES OF GUIDANCE (See guidance and personnel services, page 347.)	2 (2-0) F S
ED 421 PRINCIPLES AND PRACTICES IN INDUSTRIAL COOPERATIVE TRAINING (See industrial and technical education, page 359.)	3 (3-0) F S
ED 422 METHODS OF TEACHING INDUSTRIAL SUBJECTS (See industrial and technical education, page 359.)	3,4 (3-2) F

ED 423 METHODS AND MATERIALS IN TEACHING MODERN LANGUAGES 3 (3-0) F S  
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education with a major in modern languages and an overall 2.0 average

A study of the methods of teaching modern languages including the use of appropriate instructional materials and audio-visual equipment. Mr. Reynolds

ED 424 STUDENT TEACHING IN MODERN LANGUAGES 6 (2-15) F  
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education with a major in French or Spanish and an overall 2.0 average

This course is designed to provide the prospective teacher with an opportunity to acquire experience in the techniques and skills involved in teaching French or Spanish. Each student during the senior year will spend 10 weeks in a selected off-campus center. In addition to acquiring the competencies essential for teaching French or Spanish, the student teacher will also have an opportunity to become familiar with the total school program and to participate in as many school and community activities as time will permit during the period of student teaching.

Mr. Reynolds

ED 428 ORGANIZATION OF RELATED STUDY MATERIALS 3 (3-0) F S  
(See industrial and technical education, page 360.)

ED 440 VOCATIONAL EDUCATION 2 (2-0) F  
(See industrial and technical education, page 360.)

ED 444 STUDENT TEACHING IN INDUSTRIAL SUBJECTS 8 (2-15) F  
(See industrial and technical education, page 360.)

ED 450 METHODS AND MATERIALS IN TEACHING ENGLISH 3 (3-0) F S  
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education with a major in English and an overall 2.0 average

A study of the purposes, curricula, materials and methods of teaching the skills of reading, writing, speaking and listening in secondary schools.

Messrs. Betts, Walters

ED 451 TEACHING SECONDARY SCHOOL READING 2 (2-0) F S  
Prerequisite: Admission to teacher certification program

A study of the nature of the reading process and of principles, methods and materials for the development of effective reading attitudes and skills as applied both to developmental and remedial programs.

Staff

ED 454 STUDENT TEACHING IN ENGLISH 6 (2-15) F S  
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education with a major in English and an overall 2.0 average

This course is designed to provide the prospective teacher with an opportunity to acquire experience in the techniques and skills involved in teaching English. Each student during the senior year will spend 10 weeks in a selected off-campus center. In addition to acquiring the competencies essential for teaching English, the student teacher will also have an opportunity to become familiar with the total school program and to participate in as many school and community activities as time will permit during the period of student teaching.

Messrs. Betts, Walters

ED 460 METHODS AND MATERIALS IN TEACHING SOCIAL STUDIES 3 (3-0) F S  
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education with a major in social studies and an overall 2.0 average

A study of the purposes, methods, materials, curricula and evaluation practices appropriate for teachers of social studies at the secondary level.

Mr. Harper

ED 464 STUDENT TEACHING IN SOCIAL STUDIES 8 (2-15) F S  
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education and an overall 2.0 average

This course is designed to provide the prospective teacher with an opportunity to acquire experience in the techniques and skills involved in teaching social studies. Each student during the senior year will spend 10 weeks in a selected off-campus center. In addition to acquiring the competencies essential for teaching social studies, the student teacher will also have an opportunity to become familiar with the total school program and to participate in as many school and community activities as time will permit during the period of student teaching. Mr. Harper

ED 470 METHODS OF TEACHING MATHEMATICS 3 (3-0) F S  
(See mathematics and science education, page 386.)

ED 471 STUDENT TEACHING IN MATHEMATICS 8 (2-15) F S  
(See mathematics and science education, page 387.)

ED 472 DEVELOPING AND SELECTING TEACHING MATERIALS IN MATHEMATICS 2 (2-0) F S  
(See mathematics and science education, page 387.)

ED 475 METHODS OF TEACHING SCIENCE 3 (3-0) F  
(See mathematics and science education, page 387.)

ED 476 STUDENT TEACHING IN SCIENCE 8 (2-15) F  
(See mathematics and science education, page 387.)

ED 477 DEVELOPING AND SELECTING TEACHING MATERIALS IN SCIENCE 2 (2-0) F  
(See mathematics and science education, page 387.)

ED 480 METHODS AND MATERIALS IN TEACHING SPEECH 3 (3-0) F S  
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education with a major in speech and 2.0 overall average

A study of the purposes, curricula, materials and methods of teaching speech, including public speaking, discussion, debate, speech improvement, oral reading and play production. Mr. Munn

ED 481 STUDENT TEACHING IN SPEECH 6 (2-15) F S  
Prerequisites: PSY 304, senior standing and admission to teacher education with a major in speech and 2.0 overall average  
Corequisite: ED 480

This course is designed to provide the prospective teacher with an opportunity to acquire experience in the techniques and skills involved in teaching speech. Each student during the senior year will spend 10 weeks in a selected off-campus center. Mr. Munn

ED 482 CURRICULUM PROBLEMS IN INDUSTRIAL ARTS 2 (1-2) S  
(See industrial and technical education, page 360.)

ED 483 AN INTRODUCTION TO INSTRUCTIONAL MEDIA 3 (3-0) F S Sum.  
Prerequisites: Advanced undergraduate standing

This course provides an introduction to the characteristics and utilization of media for instruction; study and implementation of the relationship between media and instructional objectives; and elementary projects in designing, developing, and using instructional media materials. Mr. Gibson

ED 490 SENIOR SEMINAR IN AGRICULTURAL EDUCATION 1 (1-0) F S  
(See agricultural education, page 248.)

**ED 495 SENIOR SEMINAR IN MATHEMATICS AND SCIENCE EDUCATION** 3 (3-0) F S  
(See mathematics and science education, page 387.)

**ED 496 SENIOR SEMINAR IN EDUCATION** 1-3 F S Sum.  
Prerequisite: Permission of instructor

An in-depth investigation and discussion of a topic or set of problems in the field of professional education. Graduate Staff

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

**ED 500 THE COMMUNITY COLLEGE SYSTEM** 3 (3-0) F  
(See adult and community college education, page 246.)

**ED 501 (SOC 501) LEADERSHIP** 3 (3-0) F S  
(See sociology, page 453.)

**ED 502 (PS 502) PUBLIC ADMINISTRATION** 3 (3-0) F S  
(See politics, page 432.)

**ED 503 THE PROGRAMMING PROCESS IN ADULT AND COMMUNITY COLLEGE EDUCATION** 3 (3-0) F S  
(See adult and community college education, page 246.)

**ED 504 PRINCIPLES AND PRACTICES OF INTRODUCTION TO VOCATIONS** 3 (3-0) F S  
Prerequisites: Twelve hours in education

This course is designed for teachers in the public schools of North Carolina who teach Introduction to Vocations. The course emphasizes the place of the Introduction to Vocations Program in the overall school curriculum, special methods of instruction, use of teaching aids and use of student evaluation instruments. An overview is also presented in the areas of community organization, job markets, group procedures, occupational and educational information, and the changing occupational structure in our society. Staff

**ED 505 PUBLIC AREA SCHOOLS** 3 (3-0) F S  
Prerequisite: Graduate standing

Junior and community colleges, technical institutes, vocational schools and branches of universities: their development, status and prospects; policy and policy making, clientele, purposes, evaluation programs, personnel, organization administration, financing, facilities, research and development functions. Staff

**ED 506 EDUCATION OF EXCEPTIONAL CHILDREN** 3 (3-0) F  
Prerequisites: Six hours education or psychology

Discussion of principles and techniques of teaching the exceptional child with major interest on the mentally handicapped and slow learner. Practice will be given in curriculum instruction for groups of children, and individual techniques for dealing with retarded children in the average classroom. Opportunity for individual work with an exceptional child will be provided. Mrs. McCutchen

**ED 507 ANALYSIS OF READING ABILITIES** 3 (3-0) F  
Prerequisites: Six hours education or psychology

A study of tests and techniques in determining specific abilities; a study of reading retardation and factors underlying reading difficulties. Mr. Rust

**ED 508 IMPROVEMENT OF READING ABILITIES** 3 (3-0) S  
Prerequisites: Six hours education or psychology

A study of methods used in developing specific reading skills or in overcoming certain reading difficulties; a study of methods used in developing pupil vocabularies

and word analysis skills; a study of how to control vocabulary burden of reading material. Mr. Rust

ED 509 METHODS AND MATERIALS—TEACHING RETARDED CHILDREN 3 (3-0) S  
Prerequisite: ED 506

Emphasis on understanding and correlating developmental levels of mentally retarded children and appropriate educational methods and materials. Use of individual child's diagnostic data; consideration of long and short range educational goals; curriculum planning in terms of realistic usefulness; scheduling; teacher guidance of children toward social and emotional maturity. Mrs. McCutchen

ED 510 ADULT EDUCATION: HISTORY, PHILOSOPHY,  
CONTEMPORARY NATURE 3 (3-0) F  
(See adult and community college education, page 246.)

ED 511 IMPLICATIONS OF MATHEMATICAL CONTENT, STRUCTURE, AND  
PROCESSES FOR THE TEACHING OF MATHEMATICS IN THE  
ELEMENTARY SCHOOL 3 (3-0) F S  
(See mathematics and science education, page 387.)

ED 512 ACTIVE LEARNING APPROACHES TO TEACHING MATHEMATICS  
IN THE ELEMENTARY SCHOOL 3 (3-0) F S  
(See mathematics and science education, page 388.)

ED 513 (SOC 513) COMMUNITY ORGANIZATION 3 (3-0) F S  
(See sociology, page 454.)

ED 516 COMMUNITY OCCUPATIONAL SURVEYS 2 (2-0) S  
(See industrial and technical education, page 360.)

ED 517 IMPLICATIONS FOR DATA PROCESSING IN EDUCATION 3 (3-0) F S Sum.  
Prerequisites: CSC 111; ED 529 or consent of instructor

An intensive study of current attempts to apply new technologies to education. Attention will be given to research findings related to Computer Assisted Instruction, gamed instructional simulation, approaches to guidance and prescription learning as well as administrative problems pertaining to student scheduling, pupil transportation and data reporting systems. Graduate Staff

ED 518 PRINCIPLES OF SCHOOL LAW 3 (3-0) F S  
Prerequisites: Six hours graduate credit

This course will be an intensive study of the legal right, duties, privileges and responsibilities entailed in the educational enterprise. It will cover the essentials of school law in such a way that the student will be able to obtain both a general understanding of the processes of law as they affect American education and also important specific legal aspects which affect vocational education. Included are the secondary, post-secondary and adult vocational education laws and their implications. Mr. Nerden

ED 519 EARLY CHILDHOOD EDUCATION 3 (1-4) S Sum.  
Prerequisite: PSY 475 or PSY 576

This course is concerned with the plannings, selection and utilization of human resources, activities, materials and facilities relating to the education of young children. Emphasis on student observation, participation and evaluation of educational experiences appropriate for the developmental level of individual children, including flexible grouping, curricula planning and instructional techniques for an optimum learning environment. A synthesis of the student's knowledge of human development, learning theory and research findings as related to classroom application. Mrs. McCutchen

ED 520 PERSONNEL AND GUIDANCE SERVICES 3 (3-0) F S  
(See guidance and personnel services, page 347.)

ED 521 INTERNSHIP IN GUIDANCE AND PERSONNEL SERVICES Credits Arranged F S  
(See guidance and personnel services, page 347.)

ED 523 ORIENTATION AND MOBILITY OF THE VISUALLY IMPAIRED 3 (3-0) Sum.

The sensory processes and sensory cues on which independent mobility depends for the visually impaired person will be discussed. Various techniques and modes of travel will be considered. Particular emphasis will be given to instruction and background which will enable persons not teaching orientation mobility as a skill to reinforce the learning that takes place in other situations. Graduate Staff

ED 524 OCCUPATIONAL INFORMATION 3 (3-0) S  
(See guidance and personnel services, page 347.)

ED 525 TRADE ANALYSIS AND COURSE CONSTRUCTION 3 (3-0) F  
(See industrial and technical education, page 360.)

ED 526 TEACHING IN COLLEGE 3 (3-0) F S Sum.

Designed primarily for graduate students in the departments outside the School of Education, this course focuses on the development of competencies to perform the day-to-day tasks of a college teacher as well as consideration of more long-range tasks such as course development and the university responsibilities of a professor. In addition to attending lectures and other types of presentations, students will make video tapes of their teaching, develop tests, design an introductory course in teaching field, and engage in other similar types of activities. Staff

ED 527 PHILOSOPHY OF INDUSTRIAL AND TECHNICAL EDUCATION 3 (3-0) F S  
(See industrial and technical education, page 361.)

ED 528 COOPERATIVE OCCUPATIONAL EDUCATION 3 (3-0) F S  
Prerequisite: Permission of instructor

This course is designed to guide and assist in the growth patterns of individuals who are preparing to be directors, administrators or supervisors of vocational education programs at the local, state and/or national levels, with special emphasis upon the organization and operation of cooperative occupational programs. The course will cover the entire field of cooperative occupational education on secondary, post-secondary and adult levels. It will refer to the accepted essentials of cooperative education in order that the application of the philosophy to the details of planning, organization, establishment, and operation of cooperative occupational programs will be practical and meaningful. Included will be student visitations to existing quality programs in cooperative occupational education, for the purpose of studying on-site conditions related to this specialized area of study.

Mr. Smith

ED 529 CURRICULUM MATERIALS DEVELOPMENT 3 (3-0) S  
(See industrial and technical education, page 361.)

ED 530 GROUP GUIDANCE 3 (3-0) F  
(See guidance and personnel services, page 347.)

ED 531 (PSY 531) MENTAL DEFICIENCY 3 (3-0) S Sum.  
Prerequisites: Nine hours psychology and special education

This will be a course in description, causation, psychological factors and sociological aspects of mental retardation. Educational methods for the mentally retarded will be examined. The course is designed primarily for school psychologists and special-class teachers of retarded children, both educable and trainable.

Mr. Corter

- ED 533 ORGANIZATION AND ADMINISTRATION OF GUIDANCE SERVICES 3 (3-0) S  
(See guidance and personnel services, page 347.)
- ED 534 GUIDANCE IN THE ELEMENTARY SCHOOLS 3 (3-0) S  
(See guidance and personnel services, page 348.)
- ED 535 STUDENT PERSONNEL WORK IN HIGHER EDUCATION 3 (3-0) F S  
(See guidance and personnel services, page 348.)
- ED 536 STRUCTURE AND FUNCTION OF THE EYE AND  
USE OF LOW VISION 3 (5-0) Sum.  
Prerequisite: Consent of instructor
- This is a special institute in which participants will spend a minimum of 45 hours in class and class-related activities. Medical and educational consultants will discuss the structure and function of the eye, eye anomalies likely to affect children with low vision, methods of evaluating type and potential use of residual vision, and methods of teaching children to use minimal vision effectively; for teachers and administrators either presently employed in educational programs for low vision persons or planning to participate in such programs next year.
- Mrs. Rawls
- ED 537 THE EXTENSION AND PUBLIC SERVICE FUNCTION IN  
HIGHER EDUCATION 3 (3-0) S  
(See adult and community college education, page 247.)
- ED 538 INSTRUCTIONAL STRATEGIES IN ADULT AND  
COMMUNITY COLLEGE EDUCATION 3 (3-0) S  
(See adult and community college education, page 247.)
- ED 540 INDIVIDUAL AND GROUP APPRAISAL I 3 (3-0) F  
(See guidance and personnel services, page 348.)
- ED 542 CONTEMPORARY APPROACHES IN THE TEACHING OF  
SOCIAL STUDIES 3 (3-0) F S  
Prerequisites: Advanced undergraduate or graduate, must have completed student teaching
- An analysis of the principles, strategies and applications of new teaching approaches. Team-teaching, programmed instruction, inductive and reflective oriented teaching, role-playing, simulation and gaming, independent study and block-time organization will be explored.
- Graduate Staff
- ED 550 PRINCIPLES OF EDUCATIONAL ADMINISTRATION 3 (3-0) F S Sum.  
Prerequisites: Graduate standing, consent of instructor
- This course is designed as an introductory course in educational administration. Emphasizing basic principles of administration, the course will draw upon administrative theory, business, and public administration models as well as theoretical constructs from various disciplines.
- ED 552 INDUSTRIAL ARTS IN THE ELEMENTARY SCHOOL 3 (3-0) Sum.  
Prerequisites: Twelve hours education, consent of instructor
- This course is organized to help elementary teachers and principals understand how tools, materials and industrial processes may be used to vitalize and supplement the elementary school child's experiences. Practical children's projects along with the building of classroom equipment.
- Staff
- ED 554 PLANNING PROGRAMS IN AGRICULTURAL EDUCATION 3 (3-0) F S  
(See agricultural education, page 248.)

ED 555	COMPARATIVE CRAFTS AND INDUSTRIES (See industrial and technical education, page 361.)	6 Sum.
ED 559	LEARNING CONCEPTS AND THEORIES APPLIED TO ADULT AND COMMUNITY COLLEGE EDUCATION (See adult and community college education, page 247.)	3 (3-0) S
ED 560	(IA 560) NEW DEVELOPMENTS IN INDUSTRIAL ARTS EDUCATION (See industrial arts, page 364.)	3 (3-0) F S
ED 563	EFFECTIVE TEACHING Prerequisites: Twelve hours education including student teaching Analysis of the teaching-learning process; assumptions that underlie course approaches; identifying problems of importance; problem solution for effective learning; evaluation of teaching and learning; making specific plans for effective teaching.	3 (3-0) F S Staff
ED 565	AGRICULTURAL OCCUPATIONS (See agricultural education, page 248.)	3 (3-0) F S
ED 566	OCCUPATIONAL EXPERIENCE IN AGRICULTURE (See agricultural education, page 249.)	3 (3-0) F S
ED 568	ADULT EDUCATION IN AGRICULTURE (See agricultural education, page 249.)	3 (3-0) F S
ED 590	INDIVIDUAL PROBLEMS IN GUIDANCE (See guidance and personnel services, page 348.)	Maximum 6 F S
ED 591	SPECIAL PROBLEMS IN INDUSTRIAL EDUCATION (See industrial and technical education, page 361.)	Maximum 6
ED 592	SPECIAL PROBLEMS IN MATHEMATICS TEACHING (See mathematics and science education, page 388.)	3 (3-0) S
ED 593	SPECIAL PROBLEMS IN AGRICULTURAL EDUCATION (See agricultural education, page 249.)	Credits Arranged
ED 594	SPECIAL PROBLEMS IN SCIENCE TEACHING (See mathematics and science education, page 388.)	3 (0-3) F S
ED 595	(IA 595) INDUSTRIAL ARTS WORKSHOP (See industrial arts, page 364.)	3 (3-0) Sum.
ED 596	TOPICAL PROBLEMS IN ADULT AND COMMUNITY COLLEGE EDUCATION (See adult and community college education, page 247.)	Credits Arranged
ED 597	SPECIAL PROBLEMS IN EDUCATION Prerequisites: Graduate standing and consent of instructor This course is designed to provide graduate students in education the opportunity to study problem areas in professional education under the direction of a member of the graduate faculty.	3 (0-0) F S Sum. Graduate Staff
ED 598	CONCEPTS AND STRATEGIES OF UNDERSTANDING, MOTIVATING AND TEACHING DISADVANTAGED ADULTS (See adult and community college education, page 247.)	3 (3-0) S

## FOR GRADUATES ONLY

ED 600	ORGANIZATIONAL CONCEPTS AND THEORIES APPLIED TO ADULT AND COMMUNITY COLLEGE EDUCATION	3 (3-0) F
ED 601	ADMINISTRATIVE CONCEPTS AND THEORIES APPLIED TO ADULT AND COMMUNITY COLLEGE EDUCATION	3 (3-0) S
ED 602	CURRICULUM	3 (3-0) F S
ED 603	TEACHING MATHEMATICS AND SCIENCES IN HIGHER EDUCATION	3 (3-0) F
ED 604	CURRICULUM DEVELOPMENT AND EVALUATION IN SCIENCE AND MATHEMATICS	3 (3-0) F S
ED 605	EDUCATION AND SUPERVISION OF TEACHERS OF MATHEMATICS AND SCIENCE	3 (3-0) S
ED 608	SUPERVISION OF VOCATIONAL AND INDUSTRIAL ARTS EDUCATION	3 (3-0) F
ED 609	PLANNING AND ORGANIZING TECHNICAL EDUCATION PROGRAMS	3 (3-0) F
ED 610	ADMINISTRATION OF VOCATIONAL AND INDUSTRIAL ARTS EDUCATION	3 (3-0) S
ED 611	LAWS, REGULATIONS AND POLICIES AFFECTING VOCATIONAL EDUCATION	3 (3-0) F S
ED 612	FINANCE, ACCOUNTING AND MANAGEMENT OF VOCATIONAL EDUCATION PROGRAMS	3 (3-0) F S
ED 614	MODERN PRINCIPLES AND PRACTICES IN SECONDARY EDUCATION	2 (2-0) F S
ED 615	INTRODUCTION TO EDUCATIONAL RESEARCH	3 (3-0) F S
ED 617	PHILOSOPHY OF AGRICULTURAL EDUCATION	3 (3-0) S
ED 620	CASES IN EDUCATIONAL ADMINISTRATION	3 (3-0) S Sum.
ED 621	INTERNSHIP IN EDUCATION	3-9 F S Sum.
ED 630	PHILOSOPHY OF INDUSTRIAL ARTS	2 (2-0) F S
ED 631	VOCATIONAL DEVELOPMENT THEORY	3 (3-0) F
ED 633	TECHNIQUES OF COUNSELING	3 (3-0) F S
ED 635	ADMINISTRATION AND SUPERVISION OF INDUSTRIAL ARTS	2 (2-0) F S
ED 636	OBSERVATION AND SUPERVISED FIELD WORK	Maximum 3
ED 640	INDIVIDUAL AND GROUP APPRAISAL II	3 (3-0) F
ED 641	LABORATORY AND PRACTICUM EXPERIENCES IN COUNSELING	2-6 F S
ED 660	(IA 660) INDUSTRIAL ARTS CURRICULUM	3 (3-0) F S Sum.

ED 664	SUPERVISION IN AGRICULTURAL EDUCATION	3 (3-0) F S
ED 665	SUPERVISING STUDENT TEACHING	3 (3-0) F S
ED 666	SUPERVISION OF COUNSELING	3 (1-8) F S
ED 688	RESEARCH APPLICATION IN OCCUPATIONAL EDUCATION	3 (3-0) F S Sum.
ED 689	EVALUATION IN OCCUPATIONAL EDUCATION	3 (3-0) F S
ED 690	SEMINAR IN MATHEMATICS EDUCATION	Maximum 2 F S
ED 691	SEMINAR IN INDUSTRIAL EDUCATION	1 (1-0) F S
ED 692	SEMINAR IN INDUSTRIAL ARTS EDUCATION	1 (1-0) F S
ED 693	ADVANCED PROBLEMS IN AGRICULTURAL EDUCATION	Credits Arranged
ED 694	SEMINAR IN AGRICULTURAL EDUCATION	Maximum 2 1 (1-0) F S
ED 695	SEMINAR IN SCIENCE EDUCATION	Maximum 2 F S
ED 696	SEMINAR IN ADULT AND COMMUNITY COLLEGE EDUCATION	1-3 F S
ED 697	(PSY 697) ADVANCED SEMINAR IN RESEARCH DESIGN	3 (3-0) F S
ED 698	SEMINAR IN OCCUPATIONAL EDUCATION	3 (3-0) F S
ED 699	RESEARCH	Credits Arranged

## ELECTRICAL ENGINEERING

### FOR UNDERGRADUATES

EE 201 ELECTRIC CIRCUITS I 4 (2-5) F S  
Prerequisite: MA 102

Fundamental laws of electric circuits. Introduction to transient and steady-state sinusoidal analysis. Problem drill and laboratory exercises.

EE 202 ELECTRIC CIRCUITS II 4 (2-5) S  
Prerequisites: EE 201, MA 201

A continuation of EE 201. Circuit analysis by complex frequency. Introduction to two-part networks and polyphase circuits. Problem drill and laboratory exercises.

EE 211 ELECTRIC CIRCUITS I, THEORY 3 (3-0)  
Prerequisite: MA 102

Theory part of EE 201. Offered only by correspondence. Enrollment subject to approval of electrical engineering department undergraduate administrator.

EE 213 ELECTRIC CIRCUITS I, LABORATORY 1 (0-2) Sum.  
Prerequisite: EE 211

Laboratory part of EE 201. Enrollment subject to approval of electrical engineering department undergraduate administrator and limited to students who have passed EE 211.

**EE 303 ELECTROMAGNETIC FIELDS I****3 (2-3) F**

Prerequisites: EE 201, PY 208

Corequisite: MA 301

Basic principles of electromagnetic field theory in vector analysis formulation emphasizing static and quasi-static electric and magnetic fields. Maxwell's equations.

**EE 304 ELECTROMAGNETIC FIELDS II****3 (2-3) S**

Prerequisites: EE 303, MA 301

Continuation of EE 303. Vector and scalar retarded potentials. Generation and propagation of energy by electromagnetic waves. Relationship between field theory and circuit theory. Applications of electromagnetic theory to devices and to distributed parameter systems.

**EE 305 ELECTROMECHANICAL SYSTEMS****4 (3-3) S**

Prerequisites: EE 202, MA 202, EE 303

A classroom and laboratory study of the principles, performance and characteristics of direct-current and alternating-current machinery.

**EE 314 ELECTRONIC CIRCUITS****4 (2-5) F**

Prerequisites: EE 202, MA 202

A study of active devices with emphasis on bipolar and field effect transistors as elements of electric circuits. Elementary physical electronics, linear and nonlinear equivalent circuits, small signal amplifiers.

**EE 331 PRINCIPLES OF ELECTRICAL ENGINEERING****3 (3-0) F S**

Prerequisites: MA 201, PY 208

Not available to undergraduates in electrical engineering.

An introduction to the basic concepts, units and methods of analysis of electrical engineering. Current-voltage characteristics of linear and nonlinear electrical devices, analysis of d-c and a-c circuits, simple amplifiers and energy conversion devices. Demonstrations of equipment and procedures.

**EE 332 PRINCIPLES OF ELECTRICAL ENGINEERING****3 (3-0) S**

Prerequisite: EE 331

Not available to undergraduates in electrical engineering.

Power distribution systems, motors, feedback, amplifiers, oscilloscopes, voltmeters, digital information, measurements by digital means, presented from the user's viewpoint. Demonstrations of equipment and procedures.

**EE 333 PRINCIPLES OF ELECTRICAL ENGINEERING LABORATORY****1 (0-3) S**

Corequisite: EE 332

Not open to electrical engineering students.

Laboratory work in the material covered in EE 332.

**EE 334 ELECTRONICS AND INSTRUMENTATION****3 (3-0) S**

Prerequisites: EE 202 or EE 331

Not available to undergraduates in electrical engineering.

A survey of electrical and electronic circuits to provide nonelectrical engineering majors with a working understanding of electronic circuits and instruments which might be encountered in the practice of their own disciplines. Demonstrations of equipment and procedures.

**EE 335 ELECTRONICS AND INSTRUMENTATION LABORATORY****1 (0-3) S**

Corequisite: EE 334

Not open to electrical engineering students.

Laboratory work in the material covered in EE 334.

**EE 336 INDUSTRIAL POWER AND CONTROL SYSTEMS** 3 (3-0) S

Prerequisite: EE 202 or EE 331

Study of applications of power generation and transformation in industry, Transformers, DC generators and motors, single-phase and polyphase motors, manual and automatic starting and control of motors with special emphasis on use of solid-state devices.

**EE 337 INDUSTRIAL POWER LABORATORY** 1 (0-3) S

Corequisite: EE 336

Not open to electrical engineering students.

Laboratory work in the material covered in EE 336.

**EE 339 PRINCIPLES OF ELECTRICAL ENGINEERING LABORATORY** 1 (0-3) F S

Corequisite: EE 331

Not open to electrical engineering students.

Laboratory work in the material covered in EE 331.

**EE 350 ELECTRICAL POWER UTILIZATION IN MANUFACTURING PROCESSES** 3 (2-3) F S

Prerequisites: PY 212, MA 201

Not available to undergraduates in electrical engineering.

Introduction to basic electrical theory; d-c and a-c circuits and measurements; study of d-c motors and of single-phase and polyphase utilization equipment; basic control systems and brief introduction to principles of automatic control. Application examples will be drawn from the technologies of particular interest to the students in the class.

## **FOR ADVANCED UNDERGRADUATES**

**EE 401 ADVANCED ELECTRIC CIRCUITS** 3 (3-0) F S

Prerequisites: EE 202, MA 301

Transient analysis of electric circuits by the Laplace transform method, and the relationship of this method of analysis to steady-state performance, with emphasis on feedback systems.

**EE 403 ELECTRIC NETWORK DESIGN** 3 (3-0) S

Prerequisite: EE 401

The study of design methods for such electric networks as resonant systems, filters, feedback stabilizers, audio amplifier compensation and dividing networks.

**EE 406 DYNAMICAL SYSTEMS ANALYSIS** 3 (3-0) F

Prerequisites: EE 202 or 331, EM 305, MA 301

A study of dynamic systems in various branches of engineering and science with emphasis on the similarities that exist among such integrated groups of devices. Analogous elements and quantities in these fields as determined from equations basic to each. Analytical formulation of system problems in accoustical, electrical, mechanical and related fields and their solution by analog methods. Use of computers for the solution of system problems.

**EE 431 ELECTRONICS ENGINEERING** 3 (2-3) F

Prerequisite: EE 314

Comprehensive study of circuits using discrete and integrated electron devices: amplifiers, oscillators, wave-shaping circuits, nonsinusoidal generators, feedback. Emphasis is on design of solid-state circuits, through development of analytical methods using graphical, slide-rule and computer techniques.

EE 432 COMMUNICATION ENGINEERING  
Prerequisite: EE 431

3 (2-3) S

Application of electronic circuits to communication systems employing amplitude, angle and pulse modulation. Elements of complete systems: modulators, demodulators, transmitters and receivers. Introduction to information theory and noise.

EE 433 ELECTRIC POWER ENGINEERING  
Prerequisite: EE 305 or EE 332

3 (2-3) S

Electrical power supply for industrial and commercial applications; control of electrical motor drives; system safety and protection; practice in testing electrical machines.

EE 434 POWER SYSTEM ANALYSIS  
Prerequisite: EE 305

3 (3-0) F

Analysis of problems encountered in the long-distance transmission of electric power. Line parameters by the method of geometric mean distances. Circle diagrams, symmetrical components and fault calculations. Elementary concepts of power system stability. Applications of digital computers to power-system problems.

EE 435 ELEMENTS OF CONTROL  
Prerequisites: EE 314, EE 305

3 (2-3) F

Introductory theory of open- and closed-loop control. Functions and performance requirements of typical control systems and system components. Dynamic analysis of error detectors, amplifiers, motors, demodulators, analogue components and switching devices. Component transfer characteristics and block diagram representation.

EE 438 ELECTRONIC INSTRUMENTATION  
Prerequisites: MA 301 or EE 314 or EE 334

3 (3-0) S

A survey of electrical-electronic measurement techniques and operating principles of electronic instruments. Includes a study of signal sources and their equivalent circuits, basic electronics including junction and field effect transistors, operational amplifiers, switching logic and data display. Applications including low-level phenomena and noise problems will be included, with many lecture demonstrations.

EE 440 FUNDAMENTALS OF DIGITAL SYSTEMS  
Prerequisite: EE 314

3 (3-0) F S

The basic theory of digital computation and control. Introduction to number systems, data handling, relay algebra, switching logic, memory circuits, the application of electronic devices to switching circuits, and the design of computer control circuits.

EE 441 INTRODUCTION TO ELECTRON DEVICES  
Prerequisites: MA 301; PY 207; or PY 208

3 (3-0) F

A study of the basic physical principles necessary for understanding modern electronic devices. Quantum and statistical mechanic concepts are introduced at an elementary level, and these ideas form the basis for a discussion of a wide variety of devices which are used in modern engineering and instrumentation.

EE 442 INTRODUCTION TO SOLID-STATE DEVICES  
Prerequisites: EE 441 or PY 407; MA 301

3 (3-0) S

An introduction to the microscopic phenomena responsible for the operation of solid-state electronic devices. A qualitative description of the band model of solids is followed by a description of the transport properties of charge carriers. P-n junction diodes and transistors, solar cells, controlled rectifiers, tunnel diodes and unijunction transistors are treated along with more recently developed devices.

**EE 445 INTRODUCTION TO ANTENNAS****3 (2-3) F****Prerequisites:** EE 304, EE 314

An introduction to antenna engineering. Consideration will be given to radiation from single-element radiators, radiation patterns, directive properties aperture concepts, gain and impedances. Multielement antennas and arrays with various amplitude distributions and phasings, and thin linear antennas will be treated in some detail. Antennas of current usage.

**EE 448 INTRODUCTION TO MICROWAVES****3 (2-3) S****Prerequisites:** EE 304, EE 314

A study of the elementary theory and special techniques required at microwave frequencies. Both passive and active circuits will be considered. Transmission elements, special-purpose components, generators, to include klystrons, magnetrons, traveling wave tubes, and solid-state devices will be discussed. The description of microwave networks by the scattering matrix will be presented.

**EE 492 SPECIAL TOPICS IN ELECTRICAL ENGINEERING****3 (3-0 to 0-9) F S****Prerequisite:** Junior standing

A course offered as needed to cover new or special subject matter.

**FOR GRADUATES AND ADVANCED UNDERGRADUATES****EE 503 COMPUTER-AIDED CIRCUIT ANALYSIS****3 (3-0) F****Prerequisites:** EE 314, EE 401, B average in electrical engineering and mathematics

Analysis of electrical circuits with emphasis on computer methods. Steady-state and transient analysis of linear and nonlinear networks; tolerance analysis; programming considerations.

**Mr. Staudhammer****EE 504 INTRODUCTION TO NETWORK SYNTHESIS****3 (3-0) S****Prerequisites:** EE 401, B average in electrical engineering and mathematics

A study of the properties of network functions and the development of the methods of network synthesis of one-port and two-port passive structures.

**Mr. Hoadley****EE 511 ELECTRONIC CIRCUITS****3 (3-0) F****Prerequisites:** EE 314 or EE 430, B average in electrical engineering and mathematics

Electronic devices in amplifiers, feedback systems, oscillators, modulators, switching and wave-shaping circuits. Generation of nonlinear waveforms; electronic instruments; circuits basic to electronic computers. Use of complex frequency concepts to obtain generalized response. Communications, power and industrial applications. Synthesis of circuits to satisfy system requirements.

**Mr. Barclay****EE 512 COMMUNICATION THEORY****3 (3-0) F****Prerequisites:** EE 314, B average in electrical engineering and mathematics

Material basic to information-bearing signals in linear systems. Signals in the frequency and time domains, probability and associated functions, random signal theory, modulation and frequency translation, noise, sampling theory and correlation functions. Principles of information theory including information measure, signal space and channel capacity. Fundamentals of encoding. Accent on methods and problems unique to the field of digital communication. (Offered fall every year and spring 1974.)

**Messrs. Barclay, Goetze, O'Neal, Stroh****EE 516 FEEDBACK CONTROL SYSTEMS****3 (3-0) S****Prerequisites:** EE 435, or EE 401 and B average in electrical engineering and mathematics

Study of feedback systems for automatic control of physical quantities such as voltage, speed and mechanical position. Theory of regulating systems and servo-

mechanisms. Steady-state and transient responses. Evaluation of stability. Transfer function loci and root locus plots. Analysis using differential equation and operational methods. Systems compensation and introduction to design. Mr. Peterson

**EE 517 CONTROL LABORATORY**

1 (0-3) S

Corequisite: EE 516

Laboratory study of feedback systems for automatic control of physical quantities such as voltage, speed and mechanical position. Characteristics of regulating systems and servomechanisms. The laboratory work is intended to contribute to an understanding of the theory developed in EE 516. Mr. Peterson

**EE 520 FUNDAMENTALS OF LOGIC SYSTEMS**

3 (3-0) F

Prerequisites: EE 314 or EE 430, B average in electrical engineering and mathematics

A study of elementary machine language theory, computer organization and logical design, logical algebras and function minimization (map method emphasized). Introductory combinational and sequential logic including circuits, basic building blocks, and theory construction using electronic and core elements. (Offered fall every year, summer 1974 and spring 1976.) Messrs. Bell, Gault, Staudhammer

**EE 521 DIGITAL COMPUTER TECHNOLOGY AND DESIGN**

3 (3-0) S

Prerequisite: EE 520

A study of the internal organization and structure of digital systems including gates, toggle circuits, pulse circuitry and advanced machine language theory. Analysis and synthesis of the major components of computers, including the logic section, storage devices, registers, input-output and control.

Messrs. Bell, Staudhammer

**EE 530 PHYSICAL ELECTRONICS**

3 (3-0) F

Prerequisites: EE 304, B average in electrical engineering and mathematics

A study of behavior of charged particles under the influence of fields and other charged particles. Ballistics, quantum mechanics, particle statistics, electron emission and properties of dielectric and magnetic materials. (Offered fall every year, spring 1975 and summer 1973.) Mr. Matthews

**EE 533 INTEGRATED CIRCUITS**

3 (3-0) S

Prerequisites: EE 314, B average in electrical engineering and mathematics.

A study of the implementation of solid-state circuits in integrated form. Includes characteristics of epitaxial, diffused, thin and thick film approaches. Digital and linear applications are examined. Mr. Manning

**EE 535 (MAE 535) GAS LASERS**

3 (3-0) F S

(See mechanical and aerospace engineering, page 394.)

**EE 540 ELECTROMAGNETIC FIELDS AND WAVES**

3 (3-0) F

Prerequisites: EE 304, B average in electrical engineering and mathematics

Laws and concepts of static electromagnetism. Fundamental equations and their applications. Fundamentals, forms and applications of Maxwell's equations. Vector and scalar potentials, relativistic aspects of fields, energy and power. Waves in unbound and bounded regions, radiation, wave-guides and resonators. (Offered fall every year, summer 1975 and spring 1973.) Mr. Tischer

**EE 545 INTRODUCTION TO RADIO WAVE PROPAGATION**

3 (3-0) S

Prerequisites: EE 304, B average in electrical engineering and mathematics

Characteristics of plane electromagnetic waves in homogeneous and nonhomogeneous media with application to tropospheric and ionospheric propagation. Relationships between electron density, collision frequency and complex refrac-

tive index, theory of the formation and dynamics of ionospheric layers and theorems for the prediction of ionospheric propagation. Mr. Flood

EE 591, 592 SPECIAL TOPICS IN ELECTRICAL ENGINEERING 3 (3-0) F S  
 Prerequisite: B average in technical subjects

A two-semester sequence to develop new courses and to allow qualified students to explore areas of special interest. Graduate Staff

EE 593 INDIVIDUAL TOPICS IN ELECTRICAL ENGINEERING 1-3 F S  
 Prerequisite: B average in technical subjects

A course providing an opportunity for individual students to explore topics of special interest under the direction of a member of the faculty.

**FOR GRADUATES ONLY**

EE 610	NON-LINEAR ANALYSIS	3 (3-0) F
EE 611	ELECTRIC NETWORK SYNTHESIS	3 (3-0) F S
EE 613, 614	ADVANCED FEEDBACK CONTROL	3 (3-0) F S
EE 616	MICROWAVE ELECTRONICS	3 (3-0) S
EE 617	PULSE AND DIGITAL CIRCUITS	3 (3-0) S
EE 618	ANTENNAS AND RADIATION	3 (3-0) F
EE 619	GUIDED WAVES AND RESONATORS	3 (3-0) S
EE 622	ELECTRONIC PROPERTIES OF SOLID-STATE MATERIALS I	3 (3-0) S
EE 623	ELECTRONIC PROPERTIES OF SOLID-STATE MATERIALS II	3 (3-0) F
EE 624	ELECTRONIC PROPERTIES OF SOLID-STATE DEVICES	3 (3-0) S
EE 625	ADVANCED SOLID-STATE DEVICE THEORY	3 (3-0) F
EE 640	ADVANCED LOGIC CIRCUITS	3 (3-0) S
EE 641	SEQUENTIAL MACHINES	3 (3-0) F
EE 642	AUTOMATA AND ADAPTIVE SYSTEMS	3 (3-0) S
EE 651	STATISTICAL COMMUNICATION THEORY	3 (3-0) S
EE 652	INFORMATION THEORY	3 (3-0) F
EE 653	FUNDAMENTALS OF SPACE COMMUNICATIONS	3 (3-0) S
EE 654	COMMUNICATION SYSTEMS ANALYSIS	3 (3-0) S
EE 655	WAVE PHENOMENA IN PLASMA	3 (3-0) S
EE 659	PATTERN RECOGNITION	3 (3-0) F
EE 691, 692	SPECIAL STUDIES IN ELECTRICAL ENGINEERING	3 (3-0) F S

## ENGINEERING

### General Courses

#### E 101 ENGINEERING GRAPHICS I

2 (1-2) F S

The theory of graphically representing and solving spatial problems. Emphasis is placed on the development of a logical and analytic approach to problem solution. Conventional methods of graphically describing size and shape are presented and the representation of basic mechanical elements is introduced. Practical engineering applications are utilized.

Staff

#### E 120 ENGINEERING CONCEPTS

3 (2-1) F S

An introduction to engineering concepts by student involvement in realistic freshman design projects. The history, fields and functions of engineering, case studies, computational skills, and societal problems are covered.

Staff

#### E 201 SPATIAL RELATIONS AND VECTOR APPLICATIONS

3 (2-2) F S

Prerequisites: First courses in graphics and physics

A study of the spatial representation of points, lines, and planes and the determination of the lengths, sizes, and angles that exist between these elements, with the application of these studies to vector systems.

Staff

#### E 207 ENGINEERING GRAPHICS III

2 (1-3)

Prerequisite: E 101

A more exact presentation of engineering data in the graphical medium. Production dimensioning, detail and assembly production drawings, and free-hand sketching are covered. Special emphasis is placed on the use of sketching in the communication of engineering data.

Mr. Webb

#### E 240 FURNITURE GRAPHICS

3 (1-4) F

Prerequisite: E 101

Provides the student with an understanding of furniture drawings and their dimensioning. Special conventions applying to the furniture industry are covered. Free-hand sketching is emphasized.

Mr. Freeman

#### E 301 GRAPHICAL SOLUTIONS FOR NUMERICAL DATA

3 (2-2) F

Prerequisite: A first course in calculus

A study of the available graphic methods to represent and manipulate numerical data. Topics include the proper selection of coordinate systems and axes, empirical equations, curve fitting, graphical calculus, nomography, and the design of special purpose slide rules. Computer applications are demonstrated.

Mr. Hammond

#### E 321 (CSC 321) COMPUTER GRAPHICS

3 (2-2) S

Prerequisites: MA 202 or MA 212, and CSC 101 or CSC 111

The presentation of a wide range of computer-graphic methods of data manipulation in such a way that the student knows what computer-graphic methods are available and when and how they can be applied. Three-dimensional applications are covered.

Mr. Houck

#### E 432 PATENTS TRADEMARKS AND COPYRIGHTS

3 (3-0) S

Prerequisite: Junior standing

A course designed to acquaint students with the everyday patent, trademark and copyright problems that arise in engineering, scientific and industrial pursuits. It

includes the rights and remedies available to individual inventors and authors as well as companies. Consideration is also given to Patent Office procedures and practices.

Mr. Mills

**E 492 SPECIAL TOPICS IN ENGINEERING**

1-3 F S

Prerequisite: Junior standing

A course offered as needed to cover special subject matter of a non-departmental nature.

Staff

## **ENGINEERING HONORS**

**EH 346 FLUID MECHANICS**

3 (3-0) S

Prerequisites: EM 200; membership in the engineering honors program or consent of instructor

Study of the concepts and principles relating to fluid mechanics. Equilibrium of liquids and gases, kinematics and dynamics of frictionless fluids. Motion of viscous fluids. Dynamics of gases. Flow measurement techniques.

**EH 371 THERMODYNAMICS I**

3 (3-0) F

Prerequisite: Membership in the engineering honors program or consent of instructor

A study of the basic principles and concepts of thermodynamics. Particular emphasis is placed on first and second laws, their implications and applications. The properties of actual and real gases are investigated and also the interrelationships between the properties as given by the general equations of thermodynamics.

**EH 372 THERMODYNAMICS II**

3 (3-0) S

Prerequisites: EH 371; membership in the engineering honors program or consent of instructor

The statistical approach to thermodynamics and the application to determination of specific heats. Entropy and probability. The thermodynamics of fluid flow including supersonic flow. The basic laws of heat transfer. Ideal gas and vapor cycles. Introduction to chemical thermodynamics.

**EH 395 CONTEMPORARY TRENDS IN ENGINEERING AND SCIENCE**

1 (1-0) F

Prerequisite: Membership in engineering honors program or consent of instructor

Representatives from various fields of engineering or science discuss topics of current significance in their areas of interest.

**EH 401 SPECIAL TOPICS IN ENGINEERING**

1-4 F S

Prerequisite: Membership in the engineering honors program or consent of instructor

Individual projects in various phases of engineering, either of a research or design nature.

**EH 495 ENGINEERING HONORS SEMINAR**

1 (1-0) S

Prerequisite: Senior standing in the engineering honors program or consent of instructor

Individual presentation by the students of their projects conducted in connection with the honors program.

**EH 500 ENGINEERING ANALYSIS**

1-4 F S

Students working in small groups (or sometimes individually) with faculty advisors undertake the solution of realistic problems. These normally require the integration of knowledge from one or more engineering fields, physical sciences, mathematics, and occasionally life sciences; the aim is synthesis rather than mere analysis.

# ENGINEERING MECHANICS

## FOR UNDERGRADUATES

### EM 200 INTRODUCTION TO MECHANICS

3 (3-0) F S

Corequisite: MA 301

An introduction to the principles and concepts which form the basis for studies in dynamics, solid mechanics and fluid mechanics. The nature and properties of force systems and stress fields. The motion of particles and description of deformation of continuous media. The role of Newton's laws, the concepts of continuity and equilibrium, and the conservational principles in problems in mechanics. Staff

### EM 205 PRINCIPLES OF ENGINEERING MECHANICS

3 (3-0) F S

Prerequisite: PY 205

Corequisite: MA 202

Basic concepts, forces and equilibrium, distributed forces, virtual work, and inertial properties; application to mechanics, structures and systems. Staff

### EM 206 INTRODUCTORY APPLICATIONS IN MECHANICS

1 (0-2) F

Corequisite: EM 205

Principles of mechanics applied to practical problems of engineering science in which numerical techniques of computation are emphasized. Staff

### EM 211 INTRODUCTION TO APPLIED MECHANICS

3 (3-0) F S

Corequisites: MA 212, PY 212

This course is intended to acquaint the student with the concepts of particle and rigid body mechanics. The fundamentals of equilibrium, kinematics and kinetics are applied to engineering problems involving structures and machines. Staff

### EM 212 MECHANICS OF ENGINEERING MATERIALS

3 (2-1) F S

Prerequisite: EM 211

This course constitutes a study of the properties of engineering materials with special emphasis on the mechanical parameters. It is especially conceived to prepare the student for the selection and specification of materials common to engineering practice. A particular emphasis is given to mechanical aspects of materials employed in design. Staff

### EM 301 SOLID MECHANICS I

3 (3-0) F S

Prerequisite: EM 200

Introduction to the mechanics of deformable solids. Development of the equations which describe the linear elastic solid. Approximate solutions and solutions governed by the theory of elasticity to problems involving prescribed force systems, states of motion or energy inputs. Staff

### EM 302 SOLID MECHANICS II

3 (3-0) F S

Prerequisite: EM 301

Continuation of EM 301. Equations for thin plates. Introduction to the theory of plasticity. Theories of yielding, plastic stress-strain relationships and two-dimensional problems in plastic behavior. Staff

### EM 303 FLUID MECHANICS I

3 (3-0) F S

Prerequisite: EM 200 or EM 205

Development of the basic equations of fluid mechanics in general and specialized form. Application of these specialized equations to a variety of topics including (1) fluid statics, (2) inviscid, incompressible fluid flow and (3) viscous, incompressible fluid flow. Staff

**EM 304 FLUID MECHANICS II****3 (3-0) F S****Prerequisite:** EM 303

Continuation of EM 303. Further applications of the basic equations of fluid mechanics to (1) boundary layers and analysis, (2) laminar and turbulent flows and (3) compressible fluid flow. Introduction to experimental methods in fluid mechanics. **Staff**

**EM 305 ENGINEERING DYNAMICS****3 (3-0) F S****Prerequisite:** EM 205**Corequisite:** MA 301

Equations of motion; kinematics, kinetics of mass points and systems of mass points; kinematics and kinetics of rigid bodies; dynamics of nonrigid systems. **Staff**

**EM 307 MECHANICS OF SOLIDS****3 (3-0) F S****Prerequisite:** EM 205**Corequisite:** MA 301

Stresses, strains, constitutive laws, yield and fracture; application to axial, bending, torsional and plane stress states; deflection and stability analyses. **Staff**

**EM 311 EXPERIMENTAL ENGINEERING SCIENCE I****3 (1-6) F****Corequisites:** EM 303, EM 307

A course which deals from the outset with the experimental analysis concept starting with question of how observations and measurements are made. Illustrations follow of experimental methods which enable the inference of one physical variable by the observation of another but related one. **Mr. Bingham**

**EM 312 EXPERIMENTAL ENGINEERING SCIENCE II****3 (1-6) S****Prerequisite:** EM 311

The background in EM 311 is utilized in the study of broader problems which require the synthesis from several experimental methods as well as mathematical and/or numerical methods of an analytical system. **Mr. Bingham**

**EM 315 (ARC 315) ARCHITECTURAL MECHANICS I****3 (2-3) F****Prerequisite:** One semester of calculus; recommended: PY 221 or equivalent

An introduction to the mechanics of architectural structures: a lecture-workshop course in which the determinants of architectural form are related to structural function through a study of mechanics; principles of statics including particle and rigid body mechanics, force systems, equilibrium, and internal force systems. Lectures will present concepts and methods; workshops will provide an opportunity for application and exploration of lecture material. **Messrs. Clayton, Brantly**

**EM 316 (ARC 316) ARCHITECTURAL MECHANICS II****3 (2-3) S****Prerequisite:** EM 315 (ARC 315)

A continuation of EM 315 (ARC 315): a lecture-workshop course which investigates the mechanical properties of construction materials and the purpose, geometrical characteristics, behavior, and design of structural elements. Lectures will present concepts and methods; workshops will provide an opportunity for application and exploration of lecture material. **Messrs. Clayton, Brantly**

**EM 411, 412 ENGINEERING CYBERNETICS I, II****3 (1-4) F S****Prerequisite:** Senior standing in engineering mechanics or equivalent background

A year course to provide a forum for formal lectures on a range of common topics which would include, among others, the subjects of dynamics of linear and non-linear systems; hereditary and feedback couplings; continuous, discrete, random and stochastic inputs; system stability; reliability; optimization; and the ultra-stable autonomous system. A principal feature is student participation, in either

individual or collective form, in extra-class work of personal character in the design of particular engineering systems. Mr. McDonald

**EM 415 ENGINEERING SCIENCE IN CONTEMPORARY DESIGN**

2 (1-3) S

Prerequisite: Senior standing in engineering mechanics

A course in which, drawing upon the student's background in engineering sciences, current problems are analyzed. Case histories and evaluations of selected designs are discussed. Mr. Douglas

**FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**EM 501, 502 CONTINUUM MECHANICS I, II**

3 (3-0) F S

Prerequisites: EM 301, EM 303, MAE 301, MA 405

The concepts of stress and strain are presented in generalized tensor form. Emphasis is placed on the discussion and relative comparison of the analytical models for elastic, plastic, fluid, viscoelastic, granular and porous media. The underlying thermodynamic principles are presented, the associated boundary value problems are formulated and selected examples are used to illustrate the theory.

Mr. T. S. Chang

**EM 503 THEORY OF ELASTICITY I**

3 (3-0) F

Prerequisite: EM 301

Corequisite: MA 511 or MA 401

The fundamental equations governing the behavior of an elastic solid are developed in various curvilinear coordinate systems. Plane problems, as well as the St. Venant problem of bending, torsion and extension of bars are covered. Displacement fields, stress fields, Airy and complex stress functions are among the methods used to obtain solutions.

Messrs. Douglas, Smith

**EM 504 MECHANICS OF IDEAL FLUIDS**

3 (3-0) F

Prerequisite: EM 304

Corequisite: MA 513

Basic equations of ideal fluid flow; potential and stream functions; vortex dynamics; body forces due to flow fields, methods of singularities in two-dimensional flows; analytical determination of potential functions; conformal transformations; free-streamline flows.

Messrs. C. M. Chang, Edwards, Sorrell

**EM 505 MECHANICS OF VISCOUS FLUIDS I**

3 (3-0) S

Prerequisite: EM 304

Corequisite: MA 532

Equations of motion of a viscous fluid (Navier-Stokes equations); general properties of the Navier-Stokes equations; some exact solutions of the Navier-Stokes equations; boundary layer equations; some approximate methods of solution of the boundary layer equations; laminar boundary layers in axisymmetric and three-dimensional flows; unsteady laminar boundary layers.

Messrs. C. M. Chang, Edwards, Sorrell

**EM 506 MECHANICS OF COMPRESSIBLE FLUIDS I**

3 (3-0) F

Prerequisites: EM 304, MAE 302

Corequisite: MA 532

Introduction to the flow of a compressible fluid: thermodynamics and one-dimensional energy equation for a compressible gas. Acoustics, normal shock waves and expansion waves, shock tube theory, general one-dimensional flow and flow in ducts and channels.

Messrs. C. M. Chang, Sorrell

**EM 507 SYSTEMS ANALYSIS**  
Prerequisites: EM 305, MA 405

3 (3-0) F

An introduction to the principles and concepts underlying systems analysis. Major topics treated are: finite-dimensional vector spaces, matrices and linear operators, state space and state equations, linear differential systems, and equilibrium and stability. Illustrations and applications are chosen from the broad areas of engineering mechanics and dynamical systems theory. The state variable approach is emphasized.

Messrs. Gogolewski, McDonald

**EM 508 SYSTEMS SYNTHESIS**  
Prerequisite: EM 507

3 (3-0) S

A course in the design of engineering systems in which mechanics dominates.

Messrs. Gogolewski, McDonald

**EM 509 SPACE MECHANICS I**  
Prerequisites: EM 302, EM 304  
Corequisite: MA 511

3 (3-0) F

The applications of mechanics to the analysis and design of orbits and trajectories. Trajectory computation and optimization; space maneuvers; reentry trajectories; interplanetary guidance.

Messrs. Clayton, Maday

**EM 510 SPACE MECHANICS II**  
Prerequisites: EM 509, MA 511

3 (3-0) S

Continuation of EM 509. The analysis and design of guidance systems. Basic sensing devices; the characteristics of an inertial space; the theory of stabilized platforms; terrestrial inertial guidance.

Messrs. Clayton, Maday

**EM 511 THEORY OF PLATES AND SHELLS**  
Prerequisites: EM 301, MA 511

3 (3-0) F

Bending theory of thin plates; geometry of surfaces and stresses in shells. Various methods of analysis are discussed and illustrated by problems of practical interest.

Messrs. Bingham, Clayton, Gurley

**EM 521, 522 PROPERTIES OF SOLIDS I, II**  
Prerequisites: EM 307, MAT 301, PY 413

3 (3-0) F S

Micro and macro principles are applied toward an introductory understanding of material properties. The concepts of kinetic distribution and ensemble average of atomic behaviors are employed to characterize and interrelate material properties. Phenomenological behaviors and coupled effects are described within the continuum concept.

Mr. Horie

**EM 551 ADVANCED STRENGTH OF MATERIALS**  
Prerequisite: EM 301

3 (3-0) F

Stresses and strains at a point; rosette analysis; stress theories, stress concentration and fatigue; plasticity; inelastic, composite and curved beams; prestress energy methods; shear deflections; buckling problems and column design; and membrane stresses in shells.

Mr. Gurley

**EM 552 ELASTIC STABILITY**  
Prerequisites: EM 551, MA 301, MA 405

3 (3-0) S

A study of elastic and plastic stability. The stability criterion as a determinant. The energy method and the theorem of stationary potential energy. The solution of buckling problems by finite differences and the calculus of variations. The application of successive approximations to stability problems. Optimization applied to problems of aeroelastic and civil engineering structures.

Mr. Gurley

**EM 555 DYNAMICS I**

3 (3-0) F

Prerequisites: EM 301, MA 405

The theory of vibrations from the Lagrangian formulation of the equations of motion. Free and forced vibrations with and without damping, multiple degrees of freedom, coupled motion, normal mode vibrations, wave propagations in solid bodies.

Messrs. Clayton, Maday

**EM 556 DYNAMICS II**

3 (3-0) S

Prerequisites: EM 301, MA 405

The dynamics of particles and rigid bodies by the use of formulations of the laws of mechanics due to Newton, Euler, Lagrange and Hamilton. Accelerated reference frames, constraints, Euler's angles, the spinning top, the gyroscope, precision, stability, phase space and nonlinear oscillatory motion.

Messrs. Clayton, Maday

**EM 590 (PHI 590, REL 590) TECHNOLOGY AND HUMAN VALUES**

3 (0-3) F S

Prerequisites: A baccalaureate degree in a recognized field of engineering, liberal arts, science or social science; or for advanced undergraduates in these fields, two or more courses such as HI 341, UNI 301, UNI 302, UNI 401, or six hours in philosophy

An exploration from two or more disciplinary perspectives (notably those of ethical theory and cybernetic information theory) the range of ways of conceptualizing the relationship between the technologies of a society and the values of that society, and in areas of particular interests to students, a detailed analysis of contemporary instances of the interrelation of technology and human values.

Mr. McDonald

**FOR GRADUATES ONLY****EM 601, 602 UNIFYING CONCEPTS IN MECHANICS I, II**

3 (3-0) F S

**EM 603 THEORY OF ELASTICITY II**

3 (3-0) S

**EM 604 THEORY OF PLASTICITY**

3 (3-0) S

**EM 605, 606 (MAS 605, 606, OY 605, 606) ADVANCED  
GEOPHYSICAL FLUID MECHANICS I, II**

3 (3-0) F S

**EM 611 MECHANICS OF COMPRESSIBLE FLUIDS II**

3 (3-0) S

**EM 612 MECHANICS OF VISCOUS FLUIDS II**

3 (3-0) F

**EM 613, 614 (MAS 613, 614, OY 613, 614) PERTURBATION  
METHOD IN FLUID MECHANICS I, II**

3 (3-0) F S

**EM 631 (OR 631) VARIATIONAL METHODS IN OPTIMIZATION  
TECHNIQUES I**

3 (3-0) F

**EM 632 (OR 632) VARIATIONAL METHODS IN OPTIMIZATION  
TECHNIQUES II**

3 (3-0) S

**EM 641 OPTICAL MECHANICS**

3 (2-3) F

**EM 656 NONLINEAR VIBRATIONS**

3 (3-0) S

**EM 695 EXPERIMENTAL METHODS IN MECHANICS**

3 (2-3) S

**EM 697 SEMINARS IN MECHANICS**

1 (1-0) F S

EM 698 SPECIAL TOPICS IN MECHANICS

Credits Arranged F S

EM 699 RESEARCH IN MECHANICS

Credits Arranged F S

## ENGINEERING OPERATIONS

EO 491 SEMINAR IN ENGINEERING OPERATIONS

1 (1-0) F

Prerequisite: Senior standing

This seminar assists seniors in engineering operations in making the transition from a college environment to that of industry through lectures, guest speakers and class discussions. It should be scheduled for the last fall semester in residence.

## ENGLISH

(Also see Speech)

### FRESHMAN ENGLISH

Required of all Freshmen

ENG 112 COMPOSITION AND READING

3 (3-0) F S

Intensive study and practice in the basic forms and principles of expository communication; conferences. Staff

ENG 112 COMPOSITION AND READING

3 (3-0) F S

Prerequisite: ENG 111

Continued practice in expository writing; introduction to literary types; collateral reading; conferences. Staff

NOTE: Qualified students will be allowed to register for ENG 112 H and will be given credit for ENG 111 upon successful completion of the course. Eligibility for ENG 112H is based on the student's predicted grade in English, employing a formula determined by Counseling, plus a composition to be written at the first or second class meeting of the ENG 112H section.

NOTE: The prerequisite for all advanced courses in writing, language, speech, or literature is the completion of ENG 111 and ENG 112 with a grade of C or better in at least one semester. Desirable preparation for literature courses of the 300 level or above is ENG 205 or any semester of ENG 261, ENG 262, or ENG 265, ENG 266.

## WRITING

### FOR UNDERGRADUATES

ENG 200 WRITING LABORATORY

0 (0-3) F S

A three-hour noncredit remedial course in composition designed for upper-classmen, chiefly juniors and seniors, who in any curriculum may be found deficient in composition. Mr. Easley

ENG 215 PRINCIPLES OF NEWS AND ARTICLE WRITING

3 (3-0) F S

An introduction to the techniques of conducting interviews and writing news stories (including feature articles) for a variety of news media. Mrs. Bradley

ENG 321 THE COMMUNICATION OF TECHNICAL INFORMATION

3 (3-0) F S

Intensive training in the fundamentals of business and industrial expository and persuasive writing. Mrs. Bradley, Messrs. Dandridge, Davis

ENG 322 ADVANCED EXPOSITORY WRITING 3 (3-0) F

A course for upperclassmen designed to examine the rhetoric of the sentence, the paragraph and the whole discourse in order to develop awareness of the relationship between structure and effect in expository writing. A section designated ENG 322H is restricted to teacher certification English majors.

Messrs. Dandridge, Meyers

ENG 323 CREATIVE WRITING 3 (3-0) F

Especially designed for students who have demonstrated ability; emphasis on short prose fiction.

Messrs. Barrax, Owen, Walters

## LITERATURE

### FOR UNDERGRADUATES

ENG 205 READING FOR DISCOVERY 3 (3-0) F S

Selected masterworks drawn from American, English, and European literature.

Staff

ENG 261 ENGLISH LITERATURE I (Beginnings to 1790) 3 (3-0) F S

Staff

ENG 262 ENGLISH LITERATURE II (1790 to present) 3 (3-0) F S

Staff

ENG 265 AMERICAN LITERATURE I (Beginnings to 1850) 3 (3-0) F S

Staff

ENG 266 AMERICAN LITERATURE II (1850 to present) 3 (3-0) F S

Staff

ENG 290 CLASSICAL BACKGROUNDS OF ENGLISH LITERATURE 3 (3-0) F

A course designed to acquaint the student with the classical background, the central story-matter of the ancient world—Greek, Roman, and Hebrew—which has exerted such a profound influence on the civilization, and especially on the literature, of the Western world.

Mr. Lasseter

ENG 315 REPORTING AND EDITING 3 (3-0) S

Prerequisite: ENG 215

A journalism course in techniques of analyzing sources and readership; planning, organizing, and writing various kinds of articles; and editorial processes such as copyediting, headline writing, and page layout.

Mrs. Bradley

ENG 325 (REL 325) RELIGION AND THE MODERN LITERARY IMAGINATION 3 (3-0) F

(See religion, page 449.)

ENG 346 COMPARATIVE LITERATURE I 3 (3-0) F S

Selected great books ranging from the earliest Hebraic and Greek literature to the beginnings of the Renaissance.

Mrs. Smoot, Mr. Smith

ENG 347 COMPARATIVE LITERATURE II 3 (3-0) S

Masterworks of Continental literature from the Renaissance to 1900.

Mrs. Smoot

- ENG 369 AMERICAN NOVEL OF THE 19TH CENTURY 3 (3-0) S  
Analysis of selected romantic, realistic, and naturalistic novels.  
Messrs. Clark, West
- ENG 370 THE BRITISH NOVEL OF THE 18TH AND 19TH CENTURIES 3 (3-0) F  
A study of the background of the English novel from its beginnings to the end of the 19th century, and an analysis of the novel as a form.  
Miss C. Moore, Messrs. Durant, F. Moore
- ENG 371 THE MODERN NOVEL 3 (3-0) S  
A study of the background and patterns, and an analysis of major examples of the 20th-century novel.  
Miss C. Moore, Messrs. Halperen, Reynolds
- ENG 372 MODERN POETRY 3 (3-0) S  
An introductory course with the objective of defining the "modern temper" by comparison of contemporary poetry with that of the past. Reading and analysis of individual poems.  
Messrs. Lasseter, Owen
- ENG 382 SHORT PROSE FICTION 3 (3-0) S  
Contemporary British and American short stories.  
Mr. Kincheloe
- ENG 391 INTRODUCTION TO AMERICAN FOLKLORE 3 (3-0) F  
A systematic study of the principal types of folklore, combined with field work in collecting and assimilating materials from the various cultural traditions, with major emphasis on American folklore and its origins.  
Mr. Betts
- ENG 395 BLACK AMERICAN LITERATURE 3 (3-0) F S  
A survey of Black American literature from significant beginnings to the present.  
Mr. Barrax
- ENG 397 LITERATURE OF THE NON-WESTERN WORLD 3 (3-0) F  
Selected translations from the literature of Persia, India, China, and Japan.  
Messrs. Lasseter, Owen
- ENG 398 CONTEMPORARY LITERATURE I (1900 to 1940) 3 (3-0) F  
A study of a broad range of imaginative literature from the period 1900-1940 with emphasis upon themes and techniques rather than genre or nationality.  
Messrs. Heffernan, Knowles, Reynolds
- ENG 399 CONTEMPORARY LITERATURE II (1941 to Present) 3 (3-0) S  
The study of representative French, American, and British writers of the period 1940 to the present.  
Messrs. Knowles, Reynolds
- ENG 439 17TH-CENTURY ENGLISH LITERATURE 3 (3-0) S  
An examination of the major nondramatic literary figures in England during the period 1600-1700.  
Messrs. Blank, Heffernan, White
- ENG 449 THE RENAISSANCE 3 (3-0) F  
A study of nondramatic prose and poetry of the 16th century, with consideration of literary types and movements, and with special emphasis on the works of major authors.  
Messrs. Blank, T. Hester
- ENG 451 CHAUCER 3 (3-0) F S  
An undergraduate introduction to the study of Chaucer through an intensive reading of his masterpieces, *The Canterbury Tales* and *Troilus and Criseyde*.  
Messrs. Koonce, Toole

- ENG 453 THE ROMANTIC PERIOD** 3 (3-0) F  
The poetry of Wordsworth, Coleridge, Byron, Shelley, and Keats, with readings in the prose of Lamb, DeQuincey, and others. Messrs. P. Williams, Hargrave
- ENG 462 18TH-CENTURY ENGLISH LITERATURE** 3 (3-0) F  
The major figures in English literature between 1660 and 1790 in the light of social, cultural, and religious change. Messrs. Durant, White
- ENG 463 THE VICTORIAN PERIOD** 3 (3-0) S  
Major poets and selected prose writers studied against the social, economic, scientific, and theological background of the century. Messrs. Hargrave, Lasseter
- ENG 468 AMERICAN ROMANTICISM** 3 (3-0) F  
A study of major American writers from 1825 to 1865. Messrs. Kincheloe, Stein, West
- ENG 469 AMERICAN REALISM AND NATURALISM** 3 (3-0) S  
A study of major American writers from 1865 to 1935. Messrs. Kincheloe, Stein, West
- ENG 480 MODERN DRAMA** 3 (3-0) F  
Major plays from Ibsen to Albee. Mr. Halperen
- ENG 485 SHAKESPEARE** 3 (3-0) F S  
A study of the principal plays with emphasis on the development of the playwright. Messrs. Blank, Champion, Hartley, Toole, P. Williams
- ENG 496 LITERARY ANALYSIS (SENIOR SEMINAR)** 3 (3-0) F S  
Prerequisite: Consent of the department  
A flexible course in reading and criticism designed to synthesize some aspect of the student's preceding work in literature and to provide a capstone for his undergraduate program. A section designated ENG 496H, restricted to teacher certification English majors, will be offered each semester. Staff
- ENG 498 SPECIAL TOPICS IN ENGLISH** 1-6 F S  
Prerequisite: Six hours of English above the freshman level  
A detailed investigation of a special topic in language or literature, the topic and mode of study to be determined by the faculty member in consultation with the head of the English department. Staff

## FOR ADVANCED UNDERGRADUATES AND GRADUATES

- ENG 504 PROBLEMS IN COLLEGE COMPOSITION** 3 (3-0) F  
Prerequisite: Graduate standing or consent of instructor  
Directed study of the development of rhetorical skills in composition in classroom situations. Enrollment restricted to graduate assistants. Messrs. Betts, Walters
- ENG 524 MODERN ENGLISH USAGE** 3 (3-0) S  
Prerequisite: Graduate standing or consent of instructor  
An intensive study of English grammar, with attention to new developments in structural linguistics and with emphasis on current usage. Mr. Meyers
- ENG 526 HISTORY OF THE ENGLISH LANGUAGE** 3 (3-0) F S  
Prerequisite: Graduate standing or consent of instructor

A survey of the growth and development of the language from its Indo-European beginnings to the present. Mr. Meyers

ENG 561 MILTON 3 (3-0) S  
Prerequisite: ENG 261 or equivalent

An intensive reading of Milton with attention to background materials in the history and culture of 17th-century England. Messrs. F. Moore, White

ENG 575 SOUTHERN WRITERS 3 (3-0) S  
Prerequisite: ENG 266 or equivalent

A survey of the particular contribution of the South to American literature, with intensive study of selected major figures. Messrs. Kincheloe, West

ENG 578 ENGLISH DRAMA TO 1642 3 (3-0) F  
Prerequisite: ENG 261 or equivalent

Intensive study of the English drama from the beginnings to 1642. Messrs. Champion, Toole

ENG 579 ENGLISH DRAMA OF THE RESTORATION AND 18TH CENTURY 3 (3-0) S  
Prerequisite: ENG 261 or equivalent

Intensive study of the English drama from 1660 to 1800. Mr. Durant

ENG 590 LITERARY CRITICISM 3 (3-0) S  
Prerequisite: ENG 261 or equivalent

An examination of the critical process as it leads to the definition and analysis of literature, together with attention to the main literary traditions and conventions. Messrs. Halperen, P. Williams

## FOR GRADUATES ONLY

ENG 608 BIBLIOGRAPHY AND METHODOLOGY 3 (3-0) F

ENG 610 MIDDLE ENGLISH LITERATURE 3 (3-0) F  
(Offered in alternate years.)

ENG 615 AMERICAN LITERATURE OF THE COLONIAL PERIOD 3 (3-0) F  
(Offered in alternate years.)

ENG 620 16TH-CENTURY NON-DRAMATIC ENGLISH LITERATURE 3 (3-0) F

ENG 630 17TH-CENTURY ENGLISH LITERATURE 3 (3-0) S

ENG 650 19TH-CENTURY ENGLISH LITERATURE:  
THE ROMANTIC PERIOD 3 (3-0) F

ENG 651 STUDIES IN CHAUCER 3 (3-0) F

ENG 655 19TH-CENTURY AMERICAN LITERATURE:  
THE ROMANTIC PERIOD 3 (3-0) F

ENG 658 STUDIES IN SHAKESPEARE: THE TRAGEDIES 3 (3-0) F

ENG 659 STUDIES IN SHAKESPEARE: THE COMEDIES 3 (3-0) S

ENG 660 VICTORIAN PROSE 3 (3-0) S

ENG 662	18TH-CENTURY ENGLISH LITERATURE	3 (3-0) F
ENG 665	19TH-CENTURY AMERICAN LITERATURE: THE PERIOD OF REALISM AND NATURALISM	3 (3-0) S
ENG 670	20TH-CENTURY BRITISH LITERATURE (PROSE) (Offered in alternate years.)	3 (3-0) S
ENG 671	20TH-CENTURY BRITISH LITERATURE (POETRY) (Offered in alternate years.)	3 (3-0) S
ENG 675	20TH-CENTURY AMERICAN LITERATURE (PROSE) (Offered in alternate years.)	3 (3-0) F
ENG 676	20TH-CENTURY AMERICAN LITERATURE (POETRY) (Offered in alternate years.)	3 (3-0) F
ENG 680	20TH-CENTURY DRAMA (BRITISH) (Offered in alternate years.)	3 (3-0) S
ENG 681	20TH-CENTURY DRAMA (AMERICAN) (Offered in alternate years.)	3 (3-0) S
ENG 692	SPECIAL TOPICS IN AMERICAN LITERATURE	3 (3-0) F S
ENG 693	SPECIAL TOPICS IN ENGLISH LITERATURE	3 (3-0) F S
ENG 699	RESEARCH IN LITERATURE (THESIS)	Credits Arranged F S

## ENTOMOLOGY

### FOR UNDERGRADUATES

ENT 301	INTRODUCTION TO FOREST INSECTS	3 (2-2) F
Prerequisite: FOR 264		

An introductory course covering the fundamentals of classification, development, habit and control of forest insects.  
Mr. Farrier

ENT 312	INTRODUCTION TO ECONOMIC INSECTS	3 (2-2) F S
A basic course, covering the fundamentals of insect classification, development, food habits and controls. Mr. Brett		

### FOR ADVANCED UNDERGRADUATES

ENT 401 (ZO 401)	BIBLIOGRAPHIC RESEARCH IN BIOLOGY	1 (1-0) F
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A general course intended to acquaint students with literature problems of the scientist, mechanics of the library book classifications, bibliographies, abstract journals, taxonomic indexes and preparation of scientific papers in agriculture, forestry, biology and their subdivisions. (Offered fall 1974 and alternate years.)  
Mr. Farrier

ENT 410 (BS 410)	BIOLOGY OF INSECTS	3 (2-2) F
Prerequisite: ZO 201		

The course brings together current knowledge concerning major functional, behavioral, and adaptive characteristics of insects and stresses the biological principles underlying them. Topics will include growth and development, endocrines, receptor and nervous systems, flight and energetics, food, defenses, habitats, com-

munication, reproduction, orientation and learning, social organizations, and migration and dispersal. Mr. Yamamoto

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

ENT 502 INSECT DIVERSITY 4 (2-4) F  
Prerequisite: Twelve hours of biology

An introduction to the external morphology of insects and a survey of the biology and identification of immature and adult insects. Evolutionary relationships of insects and other arthropods, speciation, insect zoogeography, nomenclature, and classical and recent approaches to systematics are also considered.

Messrs. Axtell, Neunzig, Rabb, Young

ENT 503 FUNCTIONAL SYSTEMS OF INSECTS 4 (2-6) S  
Prerequisites: Twelve hours of biology, nine hours of chemistry, three hours of biochemistry, ENT 301 or equivalent

Structure of morphological variations of organ systems in insects including considerations of their histology and function. Sensory and general physiology will then lead into basic elements of insect orientation and behavior.

Messrs. Campbell, Hodgson, Yamamoto

ENT 504 INSECT MORPHOLOGY 3 (1-4) F  
Prerequisite: ENT 502

Concerned with external morphology, primary and comparative phases, with emphasis on knowledge and techniques which can be applied to specific problems. (Offered fall 1973-74 and alternate years.) Mr. Young

ENT 511 SYSTEMATIC ENTOMOLOGY 3 (1-4) F  
Prerequisite: ENT 301 or ENT 312 or equivalent

A somewhat detailed survey of the orders and families of insects, designed to acquaint the student with those groups and develop in the student some ability in the use of the taxonomic literature. (Offered fall 1974 and alternate years.)

Mr. Young

ENT 520 INSECT PATHOLOGY 3 (2-3) S  
Prerequisites: Introductory entomology and introductory microbiology

A treatment of the noninfectious and infectious diseases of insects, the etiological agents and infectious processes involved, immunological responses and applications. (Offered spring 1973 and alternate years.) Mr. Brooks

ENT 531 INSECT ECOLOGY 3 (2-2) F  
Prerequisite: ENT 502

The environmental relations of insects, including insect development, habits, distribution and abundance. (Offered fall 1973-74 and alternate years.) Mr. Rabb

ENT 541 IMMATURE INSECTS 2 (1-3) F  
Prerequisite: ENT 502 or equivalent

An advanced study of the immature stages of selected orders of insects with emphasis on generic and specific taxa. Primary consideration is given to the larval stage, but a brief treatment of eggs and pupae is also included. (Offered fall 1974 and alternate years.) Mr. Neunzig

ENT 542 ACAROLOGY 3 (2-3) S  
Prerequisite: ENT 301 or ENT 312 or ZO 201

A systematic survey of the mites and ticks with emphasis on identification, biology and control of the more common and economic forms attacking material, plants and animals including man. (Offered spring 1973 and alternate years.)

Mr. Farrier

**ENT 550 FUNDAMENTALS OF INSECT CONTROL**  
Prerequisites: ENT 312 or ENT 301

3 (2-2) F

The course is divided into two phases. The first deals with the basic causes of insect problems, an evaluation of the biological and economic aspects of insect attack and the fundamental methods employed in insect control. The second part deals with the critical chemical, physical and biological properties of compounds used for insect control. The material presented in the course is directed toward obtaining fundamental knowledge of the scientific principles underlying modern methods of protection of food, clothing, shelter and health from arthropods.

Mr. Guthrie

**ENT 562 AGRICULTURAL ENTOMOLOGY**  
Prerequisite: ENT 301 or ENT 312

3 (2-3) S

A study of the taxonomy, biology and ecology of beneficial and injurious insects and arachnids of agricultural crops. Advantages and limitations of the advanced concepts for controlling insect and mite populations on different crops will be emphasized. (Offered spring 1973 and alternate years.) Messrs Bradley, Rock

**ENT 575 (PHY 575, ZO 575) PHYSIOLOGY OF INVERTEBRATES**  
(See zoology, page 484.)

3 (3-0) S

**ENT 582 (ZO 582) MEDICAL AND VETERINARY ENTOMOLOGY**  
Prerequisites: ENT 301 or ENT 312 and ZO 315 or equivalent

3 (2-3) S

A study of the morphology, taxonomy, biology and control of the arthropod parasites and disease vectors of man and animals. The ecology and behavior of vectors in relation to disease transmission and control will be emphasized. (Offered spring 1973-74 and alternate years.) Mr. Axtell

**ENT 590 SPECIAL PROBLEMS**  
Prerequisite: Consent of instructor

Credits Arranged F S

Original research on special problems in entomology not related to a thesis problem, but designed to provide experience and training in research.

Graduate Staff

## **FOR GRADUATES ONLY**

**ENT 602 PRINCIPLES OF TAXONOMY**

3 (1-4) S

**ENT 611 BIOCHEMISTRY OF INSECTS**

3 (3-0) F

**ENT 622 INSECT TOXICOLOGY**

3 (2-3) S

**ENT 690 SEMINAR**

1 (1-0) F S

**ENT 699 RESEARCH**

Credits Arranged F S

## **NUTRITION**

**NTR 301 (ANS 301, FS 301) NUTRITION AND MAN**  
(See animal science, page 250.)

3 (3-0) F S

**NTR 415 (ANS 415, PO 415) COMPARATIVE NUTRITION**  
(See animal science, page 252, or poultry science, page 437.)

3 (3-0) F

**NTR 416 (ANS 416) QUANTITATIVE NUTRITION**  
Prerequisite: BCH 351 or equivalent

3 (1-6) F

The quantitative evaluation of dietary ingredients and utilization of nutrients, and the application of quantitative methods to the determination of nutrient requirements of animals.

NTR 490 NUTRITION SEMINAR 1 F S  
Prerequisite: Senior standing

Reviews, analysis and discussions of information and proposals relating to selected problems of current interest and concern in the field of human nutrition and allied areas.

NTR 590 TOPICAL PROBLEMS IN NUTRITION 1-6 F S  
Prerequisite: Graduate or senior standing

Discussions, readings and analysis of problems of current interest in nutrition and closely allied fields.

## FOR GRADUATES ONLY

NTR 601 AMINO ACIDS, VITAMINS AND MINERALS IN NUTRITION 4 (4-0) S

NTR 608 ENERGY METABOLISM 3 (3-0) F

NTR 690 ADVANCED SPECIAL PROBLEMS IN NUTRITION 1-6 F S

NTR 699 RESEARCH IN NUTRITION 1-6 F S

## PHYSIOLOGY

PHY 502 (ANS 502) REPRODUCTIVE PHYSIOLOGY OF VERTEBRATES 3 (3-0) S  
(See animal science, page 252.)

PHY 513 (ZO 513) COMPARATIVE PHYSIOLOGY 4 (3-3) F  
(See zoology, page 482.)

PHY 553 (BCH 553) PHYSIOLOGICAL BIOCHEMISTRY 3 (3-0) S  
(See biochemistry, page 257.)

PHY 575 (ENT 575, ZO 575) PHYSIOLOGY OF INVERTEBRATES 3 (3-0) S  
(See zoology, page 484.)

PHY 590 SPECIAL PROBLEMS IN PHYSIOLOGY Credits Arranged  
Prerequisite: Graduate standing, consent of instructor

Special study of a particular area of physiology not specifically related to the thesis problem. Particular emphasis will be placed on recent advances.

## FOR GRADUATES ONLY

PHY 604 (ANS 604) EXPERIMENTAL ANIMAL PHYSIOLOGY 4 (2-4) F

PHY 690 PHYSIOLOGY SEMINAR 1 S

PHY 695 SELECTED TOPICS IN PHYSIOLOGY 1-4

PHY 699 PHYSIOLOGICAL RESEARCH Credits Arranged

## TOXICOLOGY

TOX 510 INTRODUCTION TO BIOCHEMICAL TOXICOLOGY Prerequisite: Biochemistry, senior status	2 (2-0) F
TOX 515 ENVIRONMENTAL TOXICOLOGY Prerequisite: Two years of biology	2 (2-0) S
TOX 590 SPECIAL PROBLEMS IN TOXICOLOGY Prerequisite: Graduate standing	1-3

### FOR GRADUATES ONLY

TOX 690 TOXICOLOGY SEMINAR Prerequisite: Graduate standing	1 (1-0) S
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## FOOD SCIENCE

### FOR UNDERGRADUATES

FS 201 FOOD SCIENCE AND TECHNOLOGY	3 (2-3) F
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An introduction to the sciences involved in the processing of foods. The role of foods and the food industry in the development of man. The relationships between production, processing and consumption. Principles and methods of food preservation. Laboratories and field trips will acquaint students with typical processing operations and representative food industries.

Mr. Warren

FS 301 (ANS 301, NTR 301) NUTRITION AND MAN (See animal science, page 250.)	3 (3-0) F S
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FS 331 (BAE 331) FOOD ENGINEERING Prerequisite: PY 211 or PY 221	3 (2-3) F
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Engineering concepts and their application to the food industry will be presented. Principles of thermodynamics, fluid flow, heat transfer, refrigeration and electricity will be emphasized.

Messrs. Jones, Holmes

FS 400 FOODS AND NUTRITION Prerequisite: CH 220	3 (3-0) S
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A study of the health of an individual as related to food and the ability of his body to use food. Evaluation of normal diets and factors that promote optimal nutrition throughout life, and the application of biochemistry to utilization of foods.

Mr. Aurand

FS 402 FOOD CHEMISTRY Prerequisite: CH 220 or CH 221	3 (3-0) F
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An introduction to the biochemistry of foods with emphasis on the basic composition, structure, properties and nutritive value of food. The chemistry of changes occurring during processing and utilization of foods will also be studied.

Mr. Hansen

FS 404 (PO 404) POULTRY PRODUCTS Prerequisites: CH 101, BS 100	3 (2-3) F
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Biological principles of processing, preservation and marketing of poultry meat and eggs.

Mr. Ball

**FS 405 (MB 405) FOOD MICROBIOLOGY** 3 (2-3) F  
Prerequisite: MB 301 or MB 401

The microorganisms of importance in foods, and their cultural and metabolic activities in foods. The physical and chemical destruction of microorganisms in foods and kinetics involved. The conversion of raw foods by microorganisms into altered foods, and the nutrition, growth and preservation of the cultures involved. Foods as vectors of human pathogens. The evolution of microbiological standards for foods. Mr. Speck

**FS 409 (ANS 409) MEAT AND MEAT PRODUCTS** 3 (2-3) S  
Prerequisite: CH 220

A study of the basic principles involved in processing of beef, pork and lamb from the live animal to the various representative cured, fresh, canned and comminuted meat items currently produced. Mr. Blumer

**FS 432 FOOD ENGINEERING II** 3 (2-3) S  
Prerequisite: FS 331 (BAE 331)

The theory and principles of evaporation, drying and distillation will be discussed with emphasis on applications in the processing of foods. Instrumentation and control systems used in the food industry will also be presented. Mr. Jones

**FS 490 FOOD SCIENCE SEMINAR** 1 (1-0) S  
Prerequisite: Senior standing

A review and discussion of scientific articles, new developments and topics of current interest in the food industry. Messrs. Roberts, Warren

**FS 491 SPECIAL TOPICS IN FOOD SCIENCE** 1-6 F S  
Prerequisite: Senior standing or consent of instructor

Special topics are selected or assigned in various phases of food science. Opportunities to study current topics and/or problems and to gain additional knowledge and interpretative experience in a specific area. Staff

## **FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**FS 503 FOOD ANALYSIS** 3 (1-6) S  
Prerequisites: CH 315, BCH 351, FS 402

A study of the principles, methods and techniques necessary for quantitative physical and chemical analyses of food and food products. Results of analyses will be studied and evaluated in terms of quality standards and governing regulations. Mr. Johnson

**FS 504 ADVANCED FOOD CHEMISTRY** 3 (3-0) S  
Prerequisite: BCH 551

Studies on the molecular properties of food components, their interactions and reactions and the physico-chemical alterations occurring in the maturation, harvest, process and storage stages. Mr. Aurand

**FS 506 (MB 506) ADVANCED FOOD MICROBIOLOGY** 3 (1-6) S  
Prerequisite: FS 405 or equivalent

The interactions of microorganisms in foods and their roles in food spoilage and bioprocessing. Cellular and molecular relationships in bacterial injury, repair and aging resulting from environmental stresses. Bacterial sporulations, germination, and physiological properties of bacterial spores. Mr. Speck

**FS 511 FOOD RESEARCH AND DEVELOPMENT** 3 (2-3) S  
Prerequisites: FS 331, FS 402, FS 405

A study of the scientific principles underlying the development of new and improved food products and processes. Special emphasis will be placed on the application of research and development principles to meat, poultry and fisheries industries. Mr. Webb

**FS 516 QUALITY CONTROL OF FOOD PRODUCTS** 3 (2-3) S  
Prerequisites: FS 331, FS 402, FS 405

A study of quality control fundamentals in the food industry including specifications and standards, testing procedures, sampling, statistical and quality control and organization. Food products and industry problems will be used in the presentation with special emphasis on dairy products. Mr. Hansen

**FS 521 (HS 521) FOOD PRESERVATION** 3 (2-3) F  
Prerequisites: MB 401 or FS 405, FS 402 or BO 421

An examination of principles and methods employed in the preservation of foods. Major emphasis will be focused on thermal, freezing, drying and fermentation processes and their relationship to physical, chemical and organoleptic changes in product. In addition, the relationship of these preservation techniques to the development of an overall processing operation will be considered. Mr. Carroll

**FS 562 (HS 562) POST-HARVEST PHYSIOLOGY** 3 (3-0) S  
(See horticultural science, page 358.)

**FS 591 SPECIAL PROBLEMS IN FOOD SCIENCE** Maximum 6 F S  
Prerequisite: Graduate or senior standing

Analysis of scientific, engineering and economic problems of current interest in foods. Credit for this course will involve the scientific appraisal and solution of a selected problem. The problems are designed to provide training and experiences in research. Graduate Faculty

## FOR GRADUATES ONLY

**FS 601 THEORY OF PHYSICAL MEASUREMENTS OF BIOPOLYMERS** 3 (2-3) S

**FS 690 SEMINAR IN FOOD SCIENCE** 1 (1-0) F S

**FS 691 SPECIAL RESEARCH PROBLEMS IN FOOD SCIENCE** Credits Arranged

**FS 699 RESEARCH IN FOOD SCIENCE** Credits Arranged

## FORESTRY

### FOR UNDERGRADUATES

**FOR 101 (WPS 101) INTRODUCTION TO FOREST RESOURCES** 1 (1-0) F

The profession of forestry, its scope and opportunities; conservation of natural resources. Staff

**FOR 204 SILVICULTURE** 2 (0-6) Sum.

Sophomore Summer Camp

Prerequisite: Junior standing in forestry

Field exercises to enable the student to describe and measure factors of the forest environment, the ecology of forest communities, tree structure and growth, and tree and stand response to treatments which are normal parts of forest management operations. Mr. Duffield

- FOR 210 DENDROLOGY—GYMNOSPERMS** 2 (1-2) S  
 Prerequisite: BO 200  
 Identification, relationships and distribution of gymnosperm trees, with emphasis on the characteristics of genera and higher taxonomic groups. Mr. Duffield
- FOR 211 DENDROLOGY—ANGIOSPERMS** 2 (1-2) F  
 Prerequisite: BO 200  
 Identification, relationships and distribution of angiosperm trees, with emphasis on the characteristics of genera and higher taxonomic groups. Mr. Preston
- FOR 219 (WPS 219) FOREST ECONOMY AND ITS OPERATION** 3 (2-2) F  
 Prerequisite: EC 206 or EC 212  
 Multiple use concept of forestry; economic principles underlying production; investment problems; factors which influence demand for forest products. Mr. Steensen
- FOR 263 DENDROLOGY** 1 (0-3) Sum.  
 Sophomore Summer Camp  
 Prerequisite: Junior standing in forestry  
 Identification of trees, shrubs and woody vines of the Piedmont and mountain regions of North Carolina, principally by bark, foliage, flowers and developing fruits. Messrs. Duffield, Perry
- FOR 264 FOREST PROTECTION** 2 (0-6) Sum.  
 Sophomore Summer Camp  
 Prerequisite: Junior standing in forestry  
 Identification and control of forest insects and diseases. Behavior of fire and the meteorological factors affecting fire behavior. Suppression of a large simulated fire, including use of modern ground equipment, aircraft and communications systems. Staff
- FOR 272 FOREST MENSURATION** 3 (2-2) S  
 Scientific basis for the measurements and estimates required in the management of forest resources and the goods and services derived from forest land. Included are theory of measurements, the required procedures, instrumentation and statistical prerequisites, with emphasis on sampling problems. Mr. Steensen
- FOR 273 (WPS 273) QUANTITATIVE METHODS IN FOREST RESOURCES** 3 (2-2) F S  
 Prerequisite: Sophomore standing  
 Problem solving techniques in the areas of forestry, wood technology, pulp and paper technology and recreation resources. Historical development of past techniques, assessment of present technology, and an evaluation of problem solving tools, including an introduction to the use of computers. Mr. Gemmer
- FOR 274 MAPPING AND MENSURATION** 4 (0-12) Sum.  
 Sophomore Summer Camp  
 Prerequisite: FOR 272  
 Use of surveying instruments and graphic methods in preparation of topographic and planimetric maps of forested areas. Measurement of height, diameter, bole form and age of trees. Study of stand density, growing stock levels and financial maturity. Stem analysis sampling and site index determinations. Messrs. Jervis, Steensen
- FOR 284 UTILIZATION** 1 (0-3) Sum.  
 Sophomore Summer Camp  
 Prerequisite: Junior standing in forestry  
 Inspection of wood industries; expositions on manufacturing processes. Staff

FOR 318 (PP 318) FOREST PATHOLOGY 3 (2-3) S  
(See plant pathology, page 426.)

FOR 353 AIR PHOTO INTERPRETATION 3 (2-3) S  
Prerequisite: Junior standing

Theory, principles and techniques of utilizing air photos as data sources for planning and management of renewable resources. Particular attention will be directed to stereoscopic identification and examination of the bioecological factors of terrain, plants, growing conditions, water, wildlife and the changes brought about by the activities of man.

Mr. Lammi

FOR 405 FOREST LAND MANAGEMENT 5 (2-6-2) F  
Prerequisites: FOR 272, FOR 452

Management of forest lands for multiple benefits. The principles and techniques applied in regulating regeneration, species composition, growth and quality of woody vegetation; the use of planting, seeding, cutting, herbicides and fire in the management of vegetation. The application of financial principles in making decisions regarding investments in forest management.

Messrs. Bryant, Duffield

FOR 406 FOREST LAND INVENTORY AND PLANNING 6 (2-12) S  
Prerequisite: FOR 405

Applications of land management systems, including silviculture, protection, utilization and related problems in evaluation of assigned forest areas. Students complete a resource inventory and submit individual plans for management of the assigned tract.

Mr. Bryant

FOR 423 (WPS 423) LOGGING AND MILLING 3 (2-3) F  
(See wood and paper science, page 478.)

FOR 435 (WPS 435) SYSTEMS ANALYSIS IN FOREST PRODUCTS 3 (3-0) S  
(See wood and paper science, page 478.)

FOR 452 SILVICS 4 (3-2) S  
Prerequisites: BO 200, CH 103, PY 221 or PY 212, mathematics through calculus

Forest production can be increased by manipulating the physical environment, the genotype, and plant competition. The theoretical bases for these manipulations are the topics of this course in applied ecology.

Mr. Perry

FOR 462 ARTIFICIAL FORESTATION 2 (1-3) S

Biology of seed production for forest trees; forest tree seed collection, extraction, storage and testing; biology of tree seedling growth; soil aspects of nursery management; forest nursery operation; soil aspects of site preparation, planting and direct seeding; reforestation operations. (Offered spring 1974 and alternate years.)

Messrs. Duffield, Davey

FOR 472 RENEWABLE RESOURCE MANAGEMENT 3 (3-0) S  
Prerequisites: A basic course in biology and economics; junior or senior standing

The concepts and problems of coordinated use and management of the renewable resources namely soil, water, vegetation and fauna. Man as a biological factor interacting with other components of terrestrial ecological systems, particularly forests and related communities. Consideration is given to the interrelationships of forests, water, range-land, wildlife and outdoor recreation and their aesthetic and economic values. Inventory and management techniques and economic policies relating to renewable resources are examined and discussed. (Not open to forestry majors.)

Mr. Preston

**FOR 491 (WPS 491) SENIOR PROBLEMS IN FOREST  
RESOURCES**

Credits Arranged

Prerequisite: Consent of department

Problems selected with faculty approval in the areas of management or technology.  
Staff

**FOR 492 (WPS 492) SENIOR PROBLEMS IN FOREST RESOURCES** Credits Arranged

Prerequisite: Consent of department

Problems selected with faculty approval in the areas of management or technology.  
Staff

**FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**FOR 501 FOREST INFLUENCES AND WATERSHED MANAGEMENT** 3 (3-0) F

Prerequisite: Advanced undergraduate or graduate standing

Study of the effects of vegetation on climate, water and soil, with applications of the knowledge of forest influences to management of forest land resources, including conservation and yield of water, stabilization of streamflow and soils, reduction of sedimentation and general improvement of the environment.

Mr. Maki

**FOR 512 FOREST ECONOMICS** 3 (3-0) S

Prerequisite: Six hours of microeconomics

Objective is to gain understanding of the setting and functioning of the forest economy. Topics include: Supply and demand of industrial forest products and timber raw material; competition and pricing in the forest industries; competitive advantage of major forest regions; optimum rotation decision and financial returns to forest management; problems of timber production on non-industrial woodlands; economic analysis of non-timber forest products.

Mr. Holley

**FOR 553 FOREST PHOTOGRAMMETRY** 3 (2-3) S

Prerequisite: Basic measurements course

The stereoscopic use of aerial photographs for land use and vegetation interpretation will be emphasized. Some developments in remote sensing of environment will be reviewed, including infrared light, thermal infrared, microwave and radar imagery. Laboratory exercises include identification of plant cover and culture, measurement of elevations and heights of objects, determination of tree cover densities and volumes, road location and rudimentary mapping.

Mr. Lammi

**FOR 571 ADVANCED FOREST MENSURATION** 3 (2-2) S

Prerequisites: FOR 272, ST 311

Study of the development of mathematical models to describe forest resources phenomena; criteria for evaluating the "goodness" of such models; and methods of data collection for use in the evaluation.

Mr. Hafley

**FOR 572 CONSERVATION POLICY ISSUES** 3 (3-0) S

Prerequisite: Senior or graduate standing

Analysis of the attitudes of selected private groups and public agencies toward multiple resource development. Special attention is directed to the trends in development of forest resource policies, timber management objectives, private industry activity in forestry development, recreation and multiple use, education, research, watersheds, governmental activity, interaction in international forestry affairs and the role of professional foresters and related specialists in multiple use resource management.

Mr. Lammi

**FOR 591 FORESTRY PROBLEMS**

Credits Arranged

Prerequisite: Senior or graduate standing

Assigned or selected problems in the field of silviculture, harvesting operations, lumber manufacturing, wood science, pulp and paper science, wood chemistry or forest management. Staff

**FOR 599 (WPS 599) METHODS OF RESEARCH IN FORESTRY**

Credits Arranged

Prerequisite: Senior or graduate standing

Research procedures, problem analysis, working plan preparation interpretation and presentation of results; evaluation of selected studies by forest research organizations; techniques and constraints in the use of sample plots. Staff

**FOR GRADUATES ONLY****FOR 611 (GN 611) FOREST GENETICS**

3 (3-0) S

**FOR 612 (GN 612) ADVANCED TOPICS IN QUANTITATIVE GENETICS**

3 (3-0) F

**FOR 613 SPECIAL TOPICS IN SILVICULTURE**

3 (2-1) F

**FOR 614 ADVANCED TOPICS IN FOREST LAND MANAGEMENT**

3 (3-0) F

**FOR 691 (WPS 691) GRADUATE SEMINAR**

1 (1-0) F S

**FOR 692 ADVANCED FOREST MANAGEMENT PROBLEMS**

Credits Arranged

**FOR 699 PROBLEMS IN RESEARCH**

Credits Arranged

**GENETICS****FOR UNDERGRADUATES****GN 301 GENETICS IN HUMAN AFFAIRS**

3 (3-0) F S

Fundamental principles of genetics will be presented at a level not requiring courses in biological sciences but sufficient for an understanding of the relation of genetics to society and technology. A survey will be given of current knowledge of inheritance of human traits. Messrs. Bostain, McKenzie

**FOR ADVANCED UNDERGRADUATES****GN 411 THE PRINCIPLES OF GENETICS**

3 (3-0) F S

Prerequisite: BS 100 (Junior standing)

An introductory course. The physical and chemical basis of inheritance; genes as functional and structural units of heredity and development; qualitative and quantitative aspects of genetics variation. Mr. Mettler

**GN 412 ELEMENTARY GENETICS LABORATORY**

1 (0-2) F S

Prerequisite or corequisite: GN 411

Experiments and demonstrations to provide an opportunity to gain practical experience in crossing and classifying a variety of genetic materials including two generations of *Drosophila*. Mr. Mettler, Graduate Assistants

**FOR GRADUATES AND ADVANCED UNDERGRADUATES****GN 504 HUMAN GENETICS**

3 (3-0) S

Prerequisites: GN 301 or GN 411, or equivalent

The basic principles needed for an understanding of the genetics of man will be presented. Current knowledge and important areas of research in human genetics will be surveyed.

Messrs. Bostain, Schaffer

#### GN 505 GENETICS I

4 (3-2) F

Prerequisites: GN 411 or equivalent

Part I of a course sequence designed to serve as a foundation for graduate programs in genetics. As such, a balanced and comprehensive survey of each of the major fields of genetics must be presented in integrated form. Concepts based upon family analysis and a study of individual organisms will be presented here. Coverage will include general plant and animal genetics, biochemical and microbial genetics, and physiological and developmental genetics.

Messrs. Grosch, Kloos

#### GN 506 GENETICS II

4 (3-2) S

Prerequisite: GN 505 or consent of instructor

This course represents the second portion of a two-semester sequence in general genetics, which is presented at the intermediate level and directed primarily to beginning graduate students. Emphasis is placed on the basic principles and modern concepts of cytogenetics, population genetics, and quantitative genetics. These subjects are integrated with those of the first semester course as much as possible, with the primary synthesis being directed toward the dynamic aspects of evolutionary theory, including both intra- and inter-population phenomena.

Mr. Mettler, Staff

#### GN 508 (ANS 508) GENETICS OF ANIMAL IMPROVEMENT

3 (3-0) S

(See animal science, page 252.)

#### GN 513 CYTOGENETICS

4 (3-2) F

Prerequisite: GN 506 or consent of instructor

Classical and contemporary problems of chromosome structure, behavior and transmission. Euchromatin and heterochromatin. Recombination. Structural and numerical aberrations of chromosomes and the effects upon breeding systems of plants and animals. Interspecific hybridization. Polyploidy.

Messrs. Galletta, Gerstel

#### GN 520 (PO 520) POULTRY BREEDING

3 (2-2) F

(See poultry science, page 437.)

#### GN 532 (ZO 532) BIOLOGICAL EFFECTS OF RADIATIONS

3 (3-0) S

Prerequisites: BS 100 or GN 301 or consent of instructor

Qualitative and quantitative effects of radiations (other than the visible spectrum) on biological systems, to include both morphological and physiological aspects in a consideration of genetics, cytology, histology, and morphogenesis.

Mr. Grosch

#### GN 540 (ZO 540) EVOLUTION

3 (3-0) F

Prerequisite: GN 411, Undergraduate needs consent of instructor

The facts and theories of evolution in plants and animals. The causes and consequences of organic diversity.

Mr. Smith

#### GN 541 (CS 541, HS 541) PLANT BREEDING METHODS

3 (3-0) F

(See crop science, page 290.)

#### GN 542 (CS 542, HS 542) PLANT BREEDING FIELD PROCEDURES

2 (0-4) Sum.

(See crop science, page 290.)

GN 545 (CS 545) ORIGIN AND EVOLUTION OF CULTIVATED PLANTS 2 (2-0) S  
(See crop science, page 290.)

GN 550 (ZO 550) EXPERIMENTAL EVOLUTION 3 (3-0) F  
Prerequisite: GN 506 or consent of instructor

Experimental evolution deals with processes examined at the inter- and intra-population levels. A review of the results from experimental population studies and analyses of natural populations concerning variation patterns and adaptation, natural selection, polymorphism, hybridization, introgression, population breeding structure, isolating mechanisms, etc., is made and interpreted in relation to Darwinian and the modern synthesis concepts of the origin of species. (Offered 1973-74 and alternate years.)  
Mr. Mettler

GN 561 (BCH 561, MB 561) BIOCHEMICAL AND MICROBIAL GENETICS 3 (3-0) F  
Prerequisites: BCH 351 or BCH 551, GN 411 or GN 505, MB 401 or equivalent

A study of the development of the fields of biochemical genetics and microbial genetics emphasizing both techniques and concepts currently used in research in these areas. Includes lectures and discussions of current research publications.  
Mr. Armstrong

## FOR GRADUATES ONLY

GN 603 (ANS 603) POPULATION GENETICS IN ANIMAL IMPROVEMENT 3 (3-0) F

GN 611 (FOR 611) FOREST GENETICS 3 (3-0) S

GN 612 (FOR 612) ADVANCED TOPICS IN QUANTITATIVE GENETICS 3 (3-0) F

GN 613 (CS 613, HS 613) PLANT BREEDING THEORY 3 (3-0) S

GN 626 (ST 626) STATISTICAL CONCEPTS IN GENETICS 3 (3-0) S

GN 631 MATHEMATICAL GENETICS 3 (3-0) F

GN 633 PHYSIOLOGICAL GENETICS 3 (3-0) S

GN 641 COLLOQUIUM IN GENETICS 2 (2-0) F S

GN 691 SEMINAR 1 (1-0) F S

GN 695 SPECIAL PROBLEMS IN GENETICS 1-3 F S

GN 699 RESEARCH Credits Arranged

## GEOLOGY

### FOR UNDERGRADUATES

GY 101 EARTH SCIENCE 3 (3-0) S  
Not to be taken after GY 120

Introductory course in general geology; changes in the earth, and underlying physical and life processes.

GY 120 PHYSICAL GEOLOGY 3 (2-3) F S

Dynamic processes acting on and within the earth; materials and makeup of the

earth's crust; emphasis on engineering and agricultural applications in the South-east. Lectures, laboratories and field trips.

GY 208 ENVIRONMENTAL PHYSICAL GEOGRAPHY 3 (2-3) S

Study of the physical conditions on the earth's surface that influence human activities; factors of man's environment; including planetary conditions, geographic location, climate and weather, soils and land forms.

GY 220 PHYSICAL-HISTORICAL GEOLOGY 4 (3-3) Sum.  
Prerequisite: CH 101

A broad introductory survey of earth materials, processes and history. Common minerals and rocks. Effect of solar, gravitational, chemical and internal-thermal energy in transforming crustal constitution, structure, position and surface form. Measurement and subdivision of geologic time scale. The time scale, geosynclinal and tectonic cycles. Typical major geologic events in North America. Evolution of the main fossil groups.

GY 222 HISTORICAL GEOLOGY 3 (2-3) S  
Prerequisite: GY 120

Chronologic account of the geologic events during the development of the earth's crust, mainly in North America. Evolution and environmental significance of the principal fossil animal and plant groups. Field trips.

GY 323 PALEONTOLOGY 3 (2-3) F  
Prerequisite: GY 220 or GY 222

Study of fossil life forms, with major emphasis on classification and structure of the invertebrate animals and their application to problems of correlation of strata. Lecture, laboratories and field trips.

GY 330 CRYSTALLOGRAPHY AND MINERALOGY 3 (2-3) S  
Corequisite: GY 120

The elements of morphological crystallography. Space lattices, crystal symmetry, systems and classes. Stereographic projection of common forms. Identification of minerals by crystallographic features, cleavage, fracture, luster, color, streak, hardness, specific gravity, etc. Chemical composition, varieties, occurrence, associations, important localities and uses. Crystal structures of selected minerals.

GY 331 OPTICAL MINERALOGY AND X-RAY DIFFRACTION 4 (2-4) F  
Prerequisite: GY 330

Techniques and underlying optical theory for identifying minerals with the polarizing microscope. Determination of index of refraction and birefringence; isotropic, uniaxial or biaxial character; optical sign and orientation. Adjunct apparatus for statistical and petrographic studies. Generation of X-rays, techniques and underlying theory for identifying by X-ray diffraction.

GY 351 TECTONIC STRUCTURES 3 (2-3) F  
Prerequisite: GY 120 or GY 220

Applications of the principles of mechanics to an understanding of rock deformation. Analysis of fracture, solid flow and fluid flow structure imposed on igneous, sedimentary and metamorphic rock masses by internal crustal forces and gravitational movements. Stress-strain relations of rocks and minerals under surface conditions, and the modification of behavior which results from pore solutions and increase of confining pressure, temperature and time.

GY 415 MINERAL EXPLORATION AND EVALUATION 3 (2-3) S  
Prerequisites: GY 440, GY 452

Application of the principles of geology, geophysics, and geochemistry to the

discovery and evaluation of mineral deposits. Design of mineral exploration and development programs based on knowledge of the unique thermodynamic, geochemical and tectonic features that control mineral formation and concentrations in well-known mining districts, especially those yielding ferrous, base, and precious metals. Review of economic and technological factors governing the value of mineral deposits. Field trips.

**GY 440 IGNEOUS AND METAMORPHIC PETROLOGY**

4 (3-3) S

Prerequisite: GY 331

Minerals, rocks and mineral deposits that are formed at high temperatures and pressures by crystallization or solidification of molten magma or by solid-state recrystallization of older rocks. Application of principles of thermodynamics and of phase-rule chemistry, and of the results of modern high pressure-temperature laboratory research on the stability fields of crystalline phases, to an understanding of igneous and metamorphic rocks. Identification, classification, occurrence, origin, and economic value of the principal igneous and metamorphic rocks.

**GY 452 EXOGENIC MATERIALS AND PROCESSES**

4 (3-3) S

Prerequisite: GY 331

Identification, classification, geologic occurrences, origin and economic value of minerals, rocks and mineral deposits formed by physical, chemical, and biological processes at low temperatures and pressures at and near the earth's surface. Hydrodynamics of sediment transport and deposition, settling velocities, and size sorting, chemical and biochemical precipitation from aqueous solutions. Principles of divisions of stratified terranes into natural units, correlation of strata, identification of depositional environments, and facies analysis.

**GY 461 ENGINEERING GEOLOGY**

3 (3-0) F

Prerequisite: GY 120 or GY 220

The application of geologic principles to engineering practice; analysis of geologic factors and processes affecting specific engineering projects. (Offered fall 1973 and alternate years.)

**GY 462 GEOLOGICAL SURVEYING**

3 (1-5) S

Prerequisite: GY 120

Methods of field observation and use of geologic surveying instruments in surface and underground work; representation of geologic features by maps, sections and diagrams. Lectures, laboratories and field work.

**GY 465 GEOLOGICAL FIELD PROCEDURES**

6 Sum.

Prerequisite: GY 351 or special consent

A six week summer field course. Practical field procedures and instruments commonly used to procure geologic data for evaluating mineral deposits, solving engineering problems involving earth materials, and drawing scientific conclusions. Observation of geologic phenomena in their natural setting. Large and intermediate scale geologic mapping of surface features and large scale mapping underground in mine workings.

**GY 491, 492 SEMINAR ON SELECTED GEOLOGIC TOPICS**

1-3 F S

Reports and discussion of geological topics of current interest with attention to methodology, bibliography and research techniques.

**FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**GY 522 PETROLEUM GEOLOGY**

3 (3-0) S

Prerequisite: GY 452

Properties, origin and modes of occurrence of petroleum and natural gas. Geologic

and economic features of the principal oil and gas fields, mainly in the United States. (Offered spring 1974 and alternate years.)

GY 524 CONTINENTAL EVOLUTION 3 (3-0) F  
Prerequisites: GY 222, GY 351, GY 440, GY 452

Study of the stratigraphic and tectonic events which have shaped the continents, with emphasis upon North America; field trips. (Offered fall 1974 and alternate years.)

GY 532 ORE MICROSCOPY 3 (0-6) F  
Prerequisite: GY 331

The theory and technique of microscopic investigation of opaque ore minerals, ores and mill products produced by beneficiation of ores. Studies of compositions and textures of materials in polished surfaces are based on observations of optical and physical properties, etch reactions and microchemical tests. (Offered fall 1973 and alternate years.)

GY 542 MICROSCOPIC PETROGRAPHY 3 (1-4) S  
Prerequisite: GY 440

Systematic study by microscopic techniques of the constitution and origin of consolidated rocks.

GY 545 ADVANCED IGNEOUS PETROLOGY 3 (2-2) F  
Prerequisite: GY 440

Study of physiochemical principles related to igneous and metamorphic petrogenesis; consideration of general principles and specific problems such as differentiation, origin of magmas and metamorphism. (Offered fall 1973 and alternate years.)

GY 546 ADVANCED METAMORPHIC PETROLOGY 3 (2-2) F  
Prerequisite: GY 440

Study of physiochemical principles related to igneous petrogenesis; consideration of general principles and specific problems including the origin, differentiation and emplacement of magmas and the possible relationships of igneous processes to global tectonics. (Offered fall 1974 and alternate years.)

GY 552 EXPLORATORY GEOPHYSICS 3 (3-0) S  
Prerequisites: GY 351, PY 208 or PY 212

Fundamental principles underlying all geophysical methods; procedure and instruments involved in gravitational, magnetic, seismic, electrical and other methods of studying geological structures and conditions. Spontaneous potential, resistivity, radioactivity, temperature, and other geophysical logging methods. Study of applications and interpretations of results. (Offered spring 1973 and alternate years.)

GY 563 APPLIED SEDIMENTOLOGY 3 (2-3) F  
Prerequisites: GY 452, ST 361

Extension of GY 452, with emphasis on coarser grained detrital and chemical sedimentary rocks. Sampling of sedimentary population, critical study of assumptions underlying standard measurement techniques; treatment, testing and evaluation of sedimentary data; application to problems in sedimentology.

GY 564 LITHOSTRATIGRAPHY AND BASIN ANALYSIS 3 (2-3) S  
Prerequisite: GY 452 or graduate standing

Fabric of large sedimentary basins in terms of the spatial distribution of component major rock facies; current litho-genetic models illustrating internal lithic relationships, variability, and predictability; evolution of litho-genetic units; comparison with recent equivalents; field trips.

**GY 565 HYDROGEOLOGY****3 (3-0) S**

Prerequisite: GY 452

Occurrence and sources of surface and subsurface water. Relationships of surface water to subsurface water. Rock properties affecting infiltration, movement, lateral and vertical distribution, and quality of ground water. Determination of permeability, capacity, specific yield, and other hydraulic characteristics of aquifers. Principles of well design, legal aspects of water supplies. (Offered spring 1973 and alternate years.)

**GY 567 GEOCHEMISTRY****3 (3-0) F**

Prerequisite: CH 331 or CH 433

The quantitative distribution of elements in the earth's crust, the hydrosphere and the atmosphere. Application of the laws of chemical equilibrium and resultant chemical reactions to natural earth systems. Geochemical application of Eh-pH diagrams. Geochemical cycles. Isotope geochemistry. (Offered fall 1974 and alternate years.)

**GY 581 GEOMORPHOLOGY****3 (2-3) F**

Prerequisite: GY 120 plus appropriate background

The study of land forms and their relations to processes, stages of development, and adjustments to structure. Emphasis on mass-wasting, fluvial geomorphology of humid and arid climates, coasts, karst, and eolian processes. Lectures, map interpretations, and field trips.

**GY 582 QUATERNARY GEOLOGY****3 (3-0) S**

Prerequisite: GY 120, senior standing

Glaciology, glacial geology, Pleistocene stratigraphy, periglacial geomorphology; Quaternary volcanism, tectonism, and sea-level fluctuations; late Cenozoic climate changes; field trips. (Offered spring 1974 and alternate years.)

**GY 583 PHOTOGEOLOGY****3 (2-2) F**

Prerequisite: GY 120

The stereoscopic study of aerial photographs to obtain geologic information. The construction of bedrock and surficial geologic maps from aerial photographs. Aspects of remote sensing useful in geologic interpretation.

**GY 584 (MAS 584) MARINE GEOLOGY****3 (3-0) S**

Prerequisite: GY 452 or GY 120 plus appropriate background

Morphology, structure and origin of ocean basins with their diverse features and their relations to the continents. Physical and chemical properties of the oceans, sedimentation in the marine environment and near-shore features. The economic potential of mineral resources derived from oceanic areas. (Offered spring 1974 and alternate years.)

**GY 593 ADVANCED TOPICS IN GEOLOGY****1-6 F S**

Prerequisite: Consent of staff

Special study of some advanced phases of geology.

**FOR GRADUATES ONLY****GY 611, 612 ADVANCED ECONOMIC GEOLOGY****3 (3-0) F S****GY 695 SEMINAR****1 (1-0) F S****GY 699 GEOLOGICAL RESEARCH****Credits Arranged**

# **GUIDANCE AND PERSONNEL SERVICES**

## **FOR UNDERGRADUATES**

**ED 420 PRINCIPLES OF GUIDANCE**

**2 (2-0) F S**

**Prerequisites:** ED 344, PSY 304

This is a course designed to provide basic principles of guidance for teachers, teacher-counselors, administrators and others in the school, as well as workers in other areas such as the community agency, business, industry, group work and the like.

Among the topics covered are need for guidance; basis of guidance services, programs of studying the individual; counseling for educational, vocational, social and personal problems; group procedures in guidance. Emphasis is on the practical application of guidance principles and procedures.

**Graduate Staff**

## **FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**ED 520 PERSONNEL AND GUIDANCE SERVICES**

**3 (3-0) F S**

**Prerequisite:** Six hours of education or psychology

An introduction to the philosophies, theories, principles and practices of personnel and guidance services; the relationship of personnel services with the purposes and objectives of the school and the curriculum.

**Graduate Staff**

**ED 521 INTERNSHIP IN GUIDANCE AND PERSONNEL SERVICES** Credits Arranged **F S**

**Prerequisite:** ED 520

A continuous full-time internship of at least one-half semester. Framework of school and community. Work with students, teachers, administrators, guidance and pupil personnel workers, parents, and resource personnel in the community. Supervision of intern by guidance personnel in a school as well as by course instructors.

**Graduate Staff**

**ED 524 OCCUPATIONAL INFORMATION**

**3 (3-0) S**

**Prerequisites:** Six hours education or psychology, ED 520 or equivalent

This course is intended to give teachers, counselors, placement workers and personnel workers in business and industry an understanding of how to collect, classify, evaluate and use occupational and educational information. This will include a study of the world of work, sources of occupational information, establishing an educational-occupational information library, using educational, occupational and social information and sociological and psychological factors, influencing career planning.

**Graduate Staff**

**ED 530 GROUP GUIDANCE**

**3 (3-0) F**

**Prerequisites:** Six hours education or psychology, ED 520 or equivalent

This course is designed to help teachers, counselors, administrators and others who work with groups, or who are responsible for group guidance activities, to understand the theory and principles of effective group work, to develop skill in using specific guidance techniques, and to plan and organize group activities in the secondary school and other institutions.

**Graduate Staff**

**ED 533 ORGANIZATION AND ADMINISTRATION OF GUIDANCE SERVICES**

**3 (3-0) S**

**Prerequisites:** Graduate standing, ED 520 or equivalent

This course is designed for school guidance counselors, prospective counselors, personnel and guidance directors, and school administrators. The philosophy and scope of guidance and personnel services; the functions and responsibilities of personnel involved; basic principles and current practices in planning, developing, operating and supervising guidance and personnel services will be considered.

**Graduate Staff**

ED 534 GUIDANCE IN THE ELEMENTARY SCHOOL 3 (3-0) S  
Prerequisite: Nine hours psychology or consent of instructor

Designed for acquainting elementary school teachers, counselors and administrators with theory, practice and organization of elementary school guidance.  
Graduate Staff

ED 535 STUDENT PERSONNEL WORK IN HIGHER EDUCATION 3 (3-0) F S  
Prerequisite: Nine hours psychology or consent of instructor

Examines practices in various areas of student personnel work. Studies both structure and function of personnel programs in higher education. Graduate Staff

ED 540 INDIVIDUAL AND GROUP APPRAISAL I 3 (3-0) F  
Prerequisites: ED 520, PSY 535, or equivalent

Use of group tests of intelligence, interest and achievement in educational and career planning and in placement. Theories of intelligence and interest will be followed by laboratory in evaluating, administering and interpreting widely used group tests of intelligence, interest and achievement. Emphasis is on the use of group tests in group guidance. Graduate Staff

ED 590 INDIVIDUAL PROBLEMS IN GUIDANCE Maximum 6 F S  
Prerequisite: Six hours graduate work in department or equivalent

Intended for individual or group studies of one or more of the major problems in guidance and personnel work. Problems will be selected to meet the interests of individuals. The workshop procedure will be used whereby special projects, reports, and research will be developed by individuals and by groups. Graduate Staff

## FOR GRADUATES ONLY

ED 631 VOCATIONAL DEVELOPMENT THEORY 3 (3-0) F

ED 633 TECHNIQUES OF COUNSELING 3 (3-0) F S

ED 636 OBSERVATION AND SUPERVISED FIELD WORK Maximum 3 F S

ED 640 INDIVIDUAL AND GROUP APPRAISAL II 3 (3-0) F

ED 641 LABORATORY AND PRACTICUM EXPERIENCES IN COUNSELING 2-6 F S

ED 666 SUPERVISION OF COUNSELING 3 (1-8) F S

## HISTORY

### FOR UNDERGRADUATES

*INTRODUCTORY COURSES: (200 level) Open to all students without prerequisite. Previous course work in any particular field of history is not necessary in order to take any introductory courses.*

HI 204 WESTERN CIVILIZATION TO 1400 3 (3-0) F S

A survey of Western Civilization from earliest times to the end of the medieval era, treating the major civilizations which contributed to the development of Western Civilization until the end of the medieval period.

HI 205 WESTERN CIVILIZATION SINCE 1400 3 (3-0) F S

An introductory survey of the development of Western Civilization during the modern period from the Renaissance to the present.

HI 207 THE ANCIENT WORLD TO 180 A.D. 3 (3-0) F S

A study of the ancient cultures of the Middle East and Graeco-Roman civilization. Includes study of Egyptian, Minoan, Mycenaean, Greek, and Roman societies and cultures.

HI 208 THE MIDDLE AGES 3 (3-0) F S

A study of medieval civilization as it emerged from the declining Roman empire through its apogee in the 13th century. Treatment of the transition from the classical to the medieval world, the impact of the Germanic influx, and the political, economic, and social institutions of the High Middle Ages.

HI 209 RENAISSANCE TO WATERLOO 1300-1815 3 (3-0) F S

A survey of all aspects of the period of transition from the medieval to the modern world. Includes study of the decline of medieval institutions, the Renaissance, the Reformation and Counter-Reformation, rise of Absolutism, the English 17th century revolution, the French Revolution and Napoleonic era.

HI 210 EUROPE SINCE 1815 3 (3-0) F S

A study of the major political, economic and cultural developments in Europe since 1815. Subjects treated are the settlement of the Congress of Vienna, the impact of liberalism and nationalism, thought and culture of the 19th and 20th centuries, European imperialism, and the two World Wars and their aftermath.

HI 215 LATIN AMERICA TO 1826 3 (3-0) F S

A study of the origins and development of social, political, economic and religious institutions from pre-conquest times to the achievement of independence. The ancient American cultures; Spain and Portugal before 1492; the conquest and settlement; Spanish rule in theory and practice; economic life; the Church; land and labor; the African contribution; the Portuguese in Brazil; the independence movements.

HI 216 LATIN AMERICA SINCE 1826 3 (3-0) F S

A survey of social, political, economic and intellectual life in the 19th and 20th centuries. Major attention is given to Mexico, Argentina, Brazil, Peru and Cuba. Topics include the social structure of the new nations; 19th century liberalism; the force of tradition; relations with Europe and the United States; the Monroe Doctrine and U. S. intervention; economic change; caudillo rule; 20th century upheavals; the Mexican Revolution; Peron's Argentina; Castro and Latin America.

HI 233 THE WORLD IN THE 20TH CENTURY 3 (3-0) F S

A study of national and international problems in the Western and non-Western world, including institutions and ideas at the turn of the century, origins and effects of the First World War, the post-war challenge to Western democratic supremacy from within and without, the Second World War, and problems of the post-war period.

HI 241 UNITED STATES TO 1783 3 (3-0) F S

The European background of American history; establishment of English colonies in America; colonial historical development; the conflict with England, the securing of independence and the establishment of independent government.

HI 242 UNITED STATES 1783-1845 3 (3-0) F S

Inauguration of the new nation; territorial expansion and the westward movement; growth of democracy and social reform; development of national feeling and sectional tensions.

**HI 243 UNITED STATES 1845-1914****3 (3-0) F S**

The coming of the Civil War; the war and the reconstruction of the nation; the rise of industrialism and the Populist and Progressive response; the emergence of the United States as a world power.

**HI 244 UNITED STATES SINCE 1914****3 (3-0) F S**

The United States and the First World War; the society of the 1920's; the Great Depression and the New Deal; the Second World War and post-war international problems; the Truman and Eisenhower years; America in the 1960's and 1970's.

**HI 263 TRADITIONAL EAST ASIA: PREHISTORY TO 1800****3 (3-0) F S**

An introduction to the civilizations of China, Japan and Korea prior to the penetration of Western institutions and ideas.

**HI 264 MODERN EAST ASIA: 1800 TO PRESENT****3 (3-0) F S**

An introduction to the impact of modernization on China, Japan and the smaller nations of East Asia.

**HI 265 INTRODUCTION TO SOUTH ASIAN CIVILIZATION****3 (3-0) F S**

A general introduction to the traditional civilizations of the Indo-Pakistani sub-continent. A broad cultural approach will be used in which the historical, political, economic, religious and literary factors which shaped the central thought patterns and institutions of these civilizations will be presented. Concentration will be on the three major religious systems which are the core of the Indo-Pakistani way of life: Hinduism, Buddhism and Islam.

**HI 266 MODERN SOUTH ASIA 1700 TO PRESENT****3 (3-0) F S**

This course will deal with the major developments in the history of modern South Asia from the British conquest to the present. Emphasis will be on the development of Indian and Pakistani nationalism under British rule, on the changes in Indo-Pakistani society under the impact of modernization and on post-independence histories of India and Pakistan.

**HI 272 THE AFRO-AMERICAN IN AMERICA****3 (3-0) F S**

After a brief consideration of his African background, the course considers the particular role, experience and influence of the Afro-American at various stages in the development of the United States.

*SERVICE COURSES: (300 level) Courses required in particular curricula but also open to general election. Prerequisite: Three hours of history.*

**HI 321 ANCIENT AND MEDIEVAL SCIENCE****3 (3-0) F**

This course will focus on selected topics in the history of pre-modern science in an effort to determine how this "science" differed from the science that emerged after the "Scientific Revolution" of the seventeenth century. Attention will be paid to the relations of science to social and economic factors, technology, magic, and religion. Examples will be taken from pre-history, Mesopotamia, Egypt, China, India, Greece, Rome, Islam and the medieval and Renaissance West. Mrs. Sylla

**HI 322 RISE OF MODERN SCIENCE****3 (3-0) F S**

The "Scientific Revolution" of the 16th and 17th centuries is presented, and Newton's System analyzed. The origins of modern chemistry, geology and evolution theory are discussed, and the radical revision of Newtonian theory in the 20th century is briefly described. These developments are always considered within the context of the great historic movements of their time.

Mrs. Sylla, Mr. Mulholland

**HI 341 TECHNOLOGY IN HISTORY****3 (3-0) S**

This course traces the role of technology in society from earliest times to the present. The achievements of technology and their impact on society as a whole are examined along with the social status, education, sources of support, and relationships to church and government of scientists and engineers—in various periods.

**Mr. Mulholland****HI 351 ENGLISH HISTORY (TO 1688)****3 (3-0) F S**

A study of the history of England from the earliest times to 1688, stressing the evolution of the English constitution and the political, social, and economic background of English cultural development.

**Messrs. Carlton, Downs****HI 352 ENGLISH HISTORY (SINCE 1688)****3 (3-0) F S**

A study of the history of England from 1688 to the present, stressing the evolution of the English constitution and the political, social, and economic background of English cultural development.

**Messrs. Carlton, Downs****HI 370 (EC 370) THE RISE OF INDUSTRIALISM****3 (3-0) F**

(See economics, page 294.)

**FOR ADVANCED UNDERGRADUATES**

*NOTE: Prerequisite: (400 level) Three hours of history.*

**HI 400 CIVILIZATION OF THE ANCIENT NEAR EAST****3 (3-0) S**

A survey of the civilization of Mesopotamia and Egypt from earliest times to the fall of Babylon in 539 B.C.

**Mr. Sack****HI 403 ANCIENT GREEK CIVILIZATION****3 (3-0) S**

The history of the Hellenes is traced from the Minoan civilization through Alexander's legacy, with readings in Herodotus and Thucydides.

**Mr. Sack****HI 404 ROME TO 180 A.D.****3 (3-0) F**

Tracing the development of Rome from the Etruscans through Emperor Marcus Aurelius (180 A. D.), this course examines critically the great political achievement which saw Rome rise from a cattle-town on the Tiber to the head of an Empire. This rise is examined through readings in Livy and Tacitus.

**Mr. Riddle****HI 406 FROM ROMAN EMPIRE TO MIDDLE AGES****3 (3-0) S**

Using primarily translated Latin sources the course deals with the decline of Imperial Rome, and its succession by new Christian, Germanic, and Islamic civilizations.

**Mr. Riddle****HI 410 ITALIAN RENAISSANCE****3 (3-0) F**

Renaissance humanism, an educational ideal and an awareness of man as the sole creator in the historical world, will be examined in its relationship to the Italian republics and princedoms of the 14th through the 16th century.

**Mr. Banker****HI 411 THE PROTESTANT AND CATHOLIC REFORMATION  
OF THE 16TH CENTURY****3 (3-0) S**

A study of the conditions and criticisms which led to reform and the nature of the institutional and theological changes affected by the various churches and sects. Special attention will be given to Luther and Calvin.

**Mr. Banker**

**HI 414 THE AGE OF ABSOLUTISM****3 (3-0) F**

This course will concentrate on the development of royal absolutism in 17th century Europe, the nature of the institutions which supported it, the particular cultural forms and patterns which it generated, and the reasons for its decline in the 18th century.

**Mr. Greenlaw****HI 415 REVOLUTIONARY EUROPE****3 (3-0) S**

A broadly based analysis of Europe's first revolutionary era. Starts with the revolution in thought called the Enlightenment, then examines the causes and character of the Revolution in France, and finally traces the impact of these events in France and Europe.

**Mr. Greenlaw****HI 418 FASCISM IN GERMANY AND ITALY, 1919-1945****3 (3-0) S**

Hitler and Mussolini: two aspects of European Fascism in the interwar period.

**Mr. Suval****HI 425 TUDOR AND STUART ENGLAND****3 (3-0) S**

A study of the permanent political crisis set into motion by the Reformation which culminates in the English Civil War. Primary emphasis will be given to certain key developments in social, political and economic life such as the development of a new concept of kingship, the growing independence of Parliament, the search for religious uniformity and the changing status of the aristocracy and gentry.

**Mr. Carlton****HI 428 ENGLAND IN THE AGE OF THE AMERICAN REVOLUTION****3 (3-0) F**

A study of English political, economic, social and imperial ideas and institutions between 1763 and 1783 with special emphasis on how these affected and were effected by the War of the American Revolution.

**Mr. Downs****HI 429 TWENTIETH CENTURY BRITAIN****3 (3-0) S**

An examination of British political, social and economic history since 1914, with special reference to the effects of two world wars, the growth of the welfare state, British decline as a power, and the search for a new role in the world.

**Mr. Carlton****HI 430 FRANCE SINCE THE REVOLUTION****3 (3-0) S**

An examination of the major trends in French history since the downfall of Napoleon I. Cultural, economic, social and intellectual trends are stressed as well as the political. The ways in which France has been a seedbed for new movements in Europe are particularly noted.

**Mr. Brown****HI 432 GERMANY SINCE 1848****3 (3-0) S**

A history of Germany from the revolutions of 1848 to the present, concentrating on the problems of German nationalism and political and social reform.

**Mr. Suval****HI 435 A CENTURY OF NATIONALISM: EAST-CENTRAL EUROPE, 1848-1948****3 (3-0) S**

A study of nationalistic movements, largely within the Austro-Hungarian, Russian, Ottoman, and German Empires for independent sovereignty, and with the attainment of this goal the continuing conflicts within and between the successor states and their roles in the conflicts of the great 20th-century forces.

**Mr. Brown****HI 438 HISTORY OF RUSSIA TO 1881****3 (3-0) F**

This course surveys the social, political, economic and cultural history of Kiev Rus., Muscovy and Imperial Russia through the period of the emancipation of the serfs and the fundamental reforms that followed. While the emphasis is on internal developments, some attention is given to foreign policy.

**Mrs. Wheeler**

**HI 439 HISTORY OF RUSSIA SINCE 1881****3 (3-0) S**

This course surveys the history of Russia and the Soviet Union from the great reforms of the 19th century to modern times, with emphasis on the political, religious, and cultural trends that underlie the development of the Russian state and society and the position of the U.S.S.R. in the world today. (Some attention is given to foreign policy with emphasis on Soviet period.)

**Mrs. Wheeler****HI 442 UNITED STATES: REVOLUTION TO CONSTITUTION****3 (3-0) F**

The historical steps in the establishment of the United States as an independent nation. The conflict with Great Britain after 1763 leading to the declaring of independence; the war for American independence in its military and diplomatic aspects; the domestic problems; the foreign relations in the post-war years; the establishment of government in the new nation.

**Mr. Seegers****HI 443 THE AGE OF JEFFERSON****3 (3-0) S**

A study of the political, social, economic, intellectual and diplomatic aspects of the history of the United States from the adoption of the Constitution in 1789 through the second Madison administration. The establishment of the federal government; the implementation of Hamilton's financial system; foreign affairs during the Wars of the French Revolution; the rise of political parties; the triumph of the Jeffersonian Republicans; the territorial expansion of the United States; the War of 1812.

**Mrs. Pulley****HI 444 THE AGE OF JACKSON, 1815-1850****3 (3-0) F**

The major political, economic, cultural, and economic developments from the Era of Good Feelings to the Compromise of 1850, with readings organized around four topics related to four major interpretations of the period

**Mrs. King****HI 446 CIVIL WAR AND RECONSTRUCTION****3 (3-0) S**

A study of the period of sectional strife and war, with an examination of the impact of the war on the United States and the efforts to reconstruct the South on a national basis.

**Mr. Harris****HI 448 POPULISM AND PROGRESSIVISM****3 (3-0) F**

This course concentrates on the two most important general reform movements in the United States during the late 19th and early 20th centuries. The "agrarian crusade" and the Progressive movement are examined in the context of the economics, politics, society, and ethics of their time.

**Mr. Noblin****HI 452 RECENT AMERICA****3 (3-0) F**

An examination of some of the major problems in American life since 1939.

**Mr. Hobbs****HI 454 U. S. FOREIGN RELATIONS****3 (3-0) F**

An examination of the origins of American foreign policy and the conduct of diplomacy in the era since the United States became a world power. Stress is given to the complex array of personalities, ideas, institutions and forces involved in shaping and implementing policy.

**Mr. Beers****HI 458 SIGNIFICANT FIGURES IN 20TH CENTURY AMERICA****3 (3-0) S**

An examination of the impact of American life in the 20th century of some important people in the fields of politics, war and peace, sports and various forms of communication.

**Mr. Hobbs****HI 461 CIVILIZATION OF THE OLD SOUTH****3 (3-0) S**

A study of the distinctive features of the Old South as part of the regional

development of United States history. Consideration is given to the colonial factors in the making of the South, the development of the plantation system and Negro slavery, the Southern social order, intellectual and cultural life, economic development, and the rise of Southern nationalism. Mr. Elliott

HI 463 NORTH CAROLINA TO 1860 3 (3-0) F

A study of the history of North Carolina from the earliest explorations through the 1850's. Mr. Elliott

HI 464 NORTH CAROLINA SINCE 1860 3 (3-0) S

A study of the history of North Carolina from the eve of the Civil War to the present. Mr. Noblin

HI 467 MODERN MEXICO 3 (3-0) F

A study of the major developments in Mexican national life since 1821. The first half of the course will deal with the 19th century: the era of Santa Anna, the war with the United States, the Reform, the French intervention, and the dictatorship of Porfirio Diaz. The second half will investigate the 1910 Revolution and the resulting transformation of Mexico's political, social and economic institutions. A reading knowledge of Spanish will be helpful but is not required. Mr. Beezley

HI 469 TWENTIETH-CENTURY LATIN AMERICAN REVOLUTIONS 3 (3-0) F

A study of the variety of revolutionary changes in certain 20th century Latin American republics. Readings and lectures will concentrate on Argentina, Bolivia, Peru, and Cuba, but will include some consideration of other nations. The course will examine movements dedicated to the overthrow of traditional liberal institutions and their replacement by other political, social, and economic systems. Mr. Beezley

HI 470 (EC 470) EVOLUTION OF THE AMERICAN ECONOMY 3 (3-0) S  
(See economics, page 298.)

HI 471 REVOLUTIONARY CHINA 3 (3-0) S

An intensive examination of the failure of traditional Chinese society to find means of accommodation with the West and of the emergence of the revolutionary Communist state and society. Mr. Metzgar

HI 472 MODERN JAPAN, 1850 TO PRESENT 3 (3-0) F

An intensive examination of Japan's emergence as a nation and world power.

Staff

HI 473 20TH CENTURY ASIAN REVOLUTIONARIES 3 (3-0) S

An intensive study using psycho-historical techniques for the comparative study of the lives and works of four great figures in twentieth century Asian history: Sun Yat-sen, Mao Tse-tung, Mohandas Gandhi and Jawaharlal Nehru. Mr. Metzgar

HI 477 BRITISH EMPIRE AND COMMONWEALTH 3 (3-0) S

A history of the British Empire and Commonwealth in the 19th and 20th centuries, stressing the evolution of colonial self-government and the transformation of imperial relationships in the former British dependencies in Canada, the West Indies, Africa, Asia and the Pacific Islands. Mr. Downs

HI 491 SEMINAR IN HISTORY 3 (3-0) F S

Open to seniors majoring or concentrating in history. Open to other seniors and graduate students with departmental permission. Staff

**HI 492 SEMINAR IN HISTORY****3 (3-0) F S**

Required of all history majors. Open to other seniors and graduate students with departmental permission.

**Staff****HI 498 SPECIAL TOPICS IN HISTORY****1-6 F S**

Students in the course will read extensively on special predetermined topics focused around a central theme. The topics and themes will vary each year depending on the particular interests and competence of the assigned professor.

**Staff****FOR GRADUATES AND ADVANCED UNDERGRADUATES****HI 500 (BS 500) THE DEVELOPMENT OF CONTEMPORARY  
CONCEPTS IN BIOLOGY****3 (3-0) S**

(See biological sciences, page 262.)

*NOTE: The prerequisite for all history courses at the 500- and 600-level is six hours advanced history or equivalent.*

**HI 515 HIGH MIDDLE AGES****3 (3-0) S**

An analysis of various aspects of medieval culture. Selected topics such as the revival of the Roman Empire, monastic and papal reform, the rise of universities, the evolution of representative bodies, the Gothic style, troubadour and goliardic poetry, scholasticism, and the revival of Roman law will be examined using source readings. Research techniques will also be discussed.

**Mr. Riddle****HI 530 ERA OF THE FRENCH REVOLUTION AND NAPOLEON****3 (3-0) F**

An examination of aspects of the French Revolution and the Napoleonic era which are currently subject to differing interpretations.

**Mr. Greenlaw****HI 532 HISTORY OF GREAT BRITAIN, 1820-1914****3 (3-0) F**

A history of Great Britain from the Regency of George IV to the outbreak of World War I with special emphasis on studies in depth of the most significant developments in constitutional, religious, and economic ideas and institutions.

**Mr. Downs****HI 536 HISTORY OF INTERNATIONAL RELATIONS SINCE 1870****3 (3-0) F**

A study of European diplomatic history and of the larger area of world international relations from the Franco-Prussian war through both World Wars up to the present. Emphasis on policies and attempts to solve international problems.

**Mr. Brown****HI 545 THE AMERICAN CIVIL WAR****3 (3-0) F**

The course traces and analyzes events that led to the disruption of the union and provides an intensive study of the war, with emphasis upon its nonmilitary aspects. Only the major military campaigns are discussed.

**Mr. Harris****HI 546 RECONSTRUCTION OF THE AMERICAN UNION****3 (3-0) S**

This course is an in-depth study of the difficulties involved in the restoration and readjustment of American society after the Civil War. Special attention is given to social and economic conditions in the defeated South, military reconstruction and Republican ascendancy in the region.

**Mr. Harris****HI 548 THE AMERICAN RESPONSE TO INDUSTRIALISM****3 (3-0) S**

Focuses on the industrialization of the American economy and on efforts to deal with the ensuing transformation of American life through politics, social institutions and ideas.

**Mr. Noblin**

- HI 551 HISTORY AND PRINCIPLES OF THE ADMINISTRATION  
OF ARCHIVES AND MANUSCRIPTS 3 (3-0) F  
A study of the nature, importance and use of original manuscript resources; the history and evolution of written records, and the institutions administering them.  
Mr. Coker
- HI 552 APPLICATION OF PRINCIPLES OF ADMINISTRATION  
OF ARCHIVES AND MANUSCRIPTS 3 (3-0) F  
Internship training in the application of the principles and practices of archival management.  
Mr. Coker
- HI 561 U. S. FAR EASTERN RELATIONS 3 (3-0) S  
A study of American expansion into the Pacific and involvement in Asian affairs. Both official diplomatic relations and unofficial contacts (by missionaries, educators, businessmen, and the like) which influenced Americans, are examined.  
Mr. Beers
- HI 565 THE HISTORY OF URBAN LIFE IN THE U. S., 1607-1865 3 (3-0) F  
The history of urban life in the United States, 1607-1865. This course is designed primarily to give the student an understanding of the historical background of today's urban problems.  
Mrs. King
- HI 566 THE HISTORY OF URBAN LIFE IN THE U. S., 1865-PRESENT 3 (3-0) S  
The history of urban life in the United States, from 1865 to present. This course is designed primarily to give the student an understanding of the historical background of today's urban problems.  
Mrs. King
- HI 572 HISTORY OF SOVIET RUSSIA SINCE 1930 3 (3-0) F  
An analysis of the domestic and foreign policies of the Soviet Union since 1930 with special emphasis on the position of the Soviet Union in the world since 1945.  
Mrs. Wheeler
- HI 598 SPECIAL TOPICS IN HISTORY 1-6 F S  
An investigation of topics of particular interest to advanced students under the direction of faculty members on a tutorial basis.  
Staff

## FOR GRADUATES ONLY

- HI 601 HISTORIOGRAPHY AND HISTORICAL METHOD 3 (3-0) F
- HI 602 SEMINAR IN AMERICAN HISTORY 3 (3-0) S
- HI 604 SEMINAR IN EUROPEAN HISTORY 3 (3-0) S
- HI 606 SEMINAR IN DIPLOMATIC HISTORY 3 (3-0) S
- HI 699 RESEARCH IN HISTORY Credits Arranged

## HORTICULTURAL SCIENCE FOR UNDERGRADUATES

- HS 201 PRINCIPLES OF HORTICULTURE 3 (3-0) F S  
Attention will be directed to the basic principles involved in the application of these principles to the production, processing and utilization of fruit, vegetable and

ornamental crops. Attention will also be given to the economic importance and distribution of horticultural enterprises. Mr. Cochran

HS 211, 212 ORNAMENTAL PLANTS 3 (1-5) F S  
Prerequisite: BS 100

Distribution, botanical characters and relationships, adaptation and usage of ornamental trees, shrubs, vines and herbaceous plants. Mr. Southall

HS 301 PLANT PROPAGATION 3 (2-2) S  
Prerequisite: BS 100 or BO 200

A study of principles, methods and practices in seedage, cuttage, division, budding, grafting and other methods of propagation. Consideration will also be given to scion and stock relationships and dormancy. Mr. Nelson

HS 342 LANDSCAPE HORTICULTURE 3 (2-3) F

The application of the principles of design to the landscaping of small properties and the selecting and planting of trees, shrubs, flowers and lawn grasses. Students will be required to work out detailed landscape plans. Field trips will be made to homes and gardens. Mr. Halfacre

HS 411 NURSERY MANAGEMENT 3 (2-3) S  
Prerequisites: BS 100, SSC 200

The principles and practices involved in the production, management and marketing of field-grown and container-grown nursery plants. Field trips will be taken. Mr. Halfacre

HS 414 RESIDENTIAL LANDSCAPING 4 (2-6) S  
Prerequisites: SSC 200, HS 211, HS 212

The landscape planning and development of residential properties to create an aesthetical and functional landscape composition to complement the home. Students will be required to complete planting plans, including design, plant lists, planting details and technical specifications. Mr. Halfacre

HS 421 FRUIT PRODUCTION 3 (2-3) F  
Prerequisites: BS 100, SSC 200

A study of identification, adaptation and methods of production and marketing of the principal tree and small fruits. Modern practices as related to selection of sites, nutritional requirements, management practices and marketing procedures will be discussed. Mr. Correll

HS 432 VEGETABLE PRODUCTION 3 (2-3) F  
Prerequisites: BS 100, SSC 200

A study of the origin, importance, distribution, botanical relationships and principles of production and marketing of the major vegetable crops. Mr. Miller

HS 441 FLORICULTURE I 3 (2-3) F  
Prerequisites: BS 100, SSC 200

The scope and importance of the commercial flower industry; the basic principles and practices involved in the production and marketing of flowers grown in the greenhouse and in the field. (Offered fall 1973 and alternate years.) Mr. Larson

HS 442 FLORICULTURE II 3 (2-3) S  
Prerequisites: BS 100, SSC 200

Principles and methods of production of commercial flower crops in the greenhouse and in the field including fertilization, moisture, temperature and light relationships, insect and disease control, and marketing of cut flowers and pot plants. (Offered spring 1974 and alternate years.) Mr. Larson

**HS 471 ARBORICULTURE****3 (2-2) S****Prerequisites:** BS 100, SSC 200

A study of the principles and practices in the care and maintenance of ornamental trees and shrubs, such as pruning, fertilization, control of insects and diseases, and tree surgery. Field trips will be taken. (Offered spring 1974 and alternate years.)

**Mr. Cannon****HS 491 SENIOR SEMINAR IN HORTICULTURAL SCIENCE****1 (1-0) F S****Prerequisite:** Consent of department

Presentation of scientific articles, progress reports in research, and special problems in horticulture and related fields.

**Mr. Donoho****FOR GRADUATES AND ADVANCED UNDERGRADUATES****HS 514 (CS 514) PRINCIPLES AND METHODS IN WEED SCIENCE****3 (2-2) S****Prerequisite:** CS 414 or equivalent

Studies of the losses caused by weeds, the ecology of weeds, biological control, basic concepts of weed management, herbicide-crop relationships and herbicide development. Introduction to greenhouse and bioassay techniques used in herbicide work and to field research techniques supplemented by laboratory and field exercises.

**Messrs. Monaco, Schrader****HS 521 (FS 521) FOOD PRESERVATION****3 (2-3) F**

(See food science, page 336.)

**HS 541 (GN 541, CS 541) PLANT BREEDING METHODS****3 (3-0) F**

(See crop science, page 290.)

**HS 542 (GN 542, CS 542) PLANT BREEDING FIELD PROCEDURES****2 (0-4) Sum.**

(See crop science, page 290.)

**HS 552 GROWTH OF HORTICULTURAL PLANTS****3 (2-3) F****Prerequisite:** BO 421

An examination of metabolism underlying growth and development of horticultural plants throughout their life cycles. Biosynthetic pathways which are unique to higher plants will receive strong emphasis. The roles of hormones, growth regulators, and environmental factors will be considered.

**Mr. Pharr****HS 562 (FS 562) POST-HARVEST PHYSIOLOGY****3 (3-0) S****Prerequisite:** BO 421

A study of chemical and physiological changes that occur during handling, transportation and storage which affect the quality of horticultural crops. Consideration will be given to pre- and post-harvest conditions which influence these changes.

**Mr. Ballinger****HS 599 RESEARCH PRINCIPLES****Credits Arranged****Prerequisite:** Consent of instructor

Investigation of a problem in horticulture under the direction of the instructor. The students obtain practice in experimental techniques and procedures, critical review of literature and scientific writing. The problem may last one or two semesters. Credit will be determined by the nature of the problem, not to exceed a total of four hours.

**Graduate Staff****FOR GRADUATES ONLY****HS 613 (CS 613, GN 613) PLANT BREEDING THEORY****3 (3-0) S**

HS 614	(CS 614, SSC 614) HERBICIDE BEHAVIOR IN PLANTS AND SOILS	3 (3-0) F
HS 621	METHODS AND EVALUATION OF HORTICULTURAL RESEARCH	3 (3-0) F
HS 622	MINERAL NUTRITION IN PLANTS	3 (2-3) S
HS 691	SEMINAR	1 (1-0) F S
HS 699	RESEARCH	Credits Arranged

## INDUSTRIAL AND TECHNICAL EDUCATION FOR UNDERGRADUATES

ED 100 INTRODUCTION TO INDUSTRIAL EDUCATION 2 (2-0) F  
The place of vocational education in a program of public education and the fundamental principles upon which this work is based. Mr. Parker

ED 305 ANALYSIS OF TECHNICAL EDUCATION PROGRAMS AND  
COURSE CONSTRUCTION 3 (3-0) S  
Prerequisites: ED 100, advanced undergraduate standing

Principles and techniques of selecting and analyzing suitable teaching activities and arranging such material into a functional instructional order. Instructional units prepared will be based on an analysis of a technical occupation or activity. A detailed course of study will be prepared. Mr. Shore

ED 327 HISTORY AND PHILOSOPHY OF INDUSTRIAL AND  
TECHNICAL EDUCATION 3 (3-0) F  
Prerequisite: ED 100

Historical study of trade and technical education movement. Place, function and changing concepts of industrial and technical education in American education. Economic, sociological and psychological aspects. Mr. Nerden

ED 405 INDUSTRIAL AND TECHNICAL EDUCATION SHOP AND  
LABORATORY PLANNING 3 (3-0) F  
Prerequisites: Senior standing, six hours of drawing and design

Principles and techniques to assist teachers in planning and organizing shop and laboratory facilities. Problems of locating and equipping vocational schools; the planning and layout of shops and related technology laboratories and classrooms. Individual and group assignments on planning and layout of post-secondary school buildings. Mr. Shore

ED 421 PRINCIPLES AND PRACTICES IN INDUSTRIAL COOPERATIVE  
TRAINING 3 (3-0) F S  
Prerequisites: ED 327, ED 344

A study of the developments, objectives and principles of industrial cooperative training. The organization, promotion and management of programs in this area of vocational education. Mr. Smith

ED 422 METHODS OF TEACHING INDUSTRIAL SUBJECTS 3, 4 (3-2) F  
Prerequisites: ED 344, PSY 304  
For majors only.

A study of effective methods and techniques of teaching industrial subjects. Emphasis is given to class organization; student-teacher planning; methods of teaching manipulative skills and related information; lesson planning; shop safety; and evaluation. Teaching problems will be studied and analyzed following directed observations in the public schools. Staff

ED 428 ORGANIZATION OF RELATED STUDY MATERIALS  
Prerequisites: ED 327, ED 344

3 (3-0) F S

The principles of selecting and organizing both technical and general related instructional material for trade extension and industrial cooperative training classes.  
Mr. Smith

ED 440 VOCATIONAL EDUCATION  
Prerequisites: ED 444, PSY 304

2 (2-0) F

A comprehensive study of the types of vocational education of less than college grade, provided for through federal legislation; an evaluation of the effectiveness of the program; and a detailed study of the North Carolina Plan.  
Staff

ED 444 STUDENT TEACHING IN INDUSTRIAL SUBJECTS

8 (2-15) F

Prerequisites: ED 334, PSY 304, senior standing, admission to teacher education and an overall 2.0 average

Students in the industrial arts, vocational industrial education and technical education curricula will devote 10 weeks during the fall semester to full-time, off-campus student teaching in selected public schools throughout the State. They will be assigned to their teaching center in the preceding spring and will report to their supervising teachers when the public schools (to which they are assigned) open in the fall. During the remainder of the term, additional courses will be taken in concentrated form.  
Staff

ED 482 CURRICULUM PROBLEMS IN INDUSTRIAL ARTS

2 (1-2) S

Prerequisites: PSY 304 or six hours in education

This course is devoted to planning and organizing learning units in industrial arts.  
Staff

ED 483 AN INTRODUCTION TO INSTRUCTIONAL MEDIA

3 (3-0) F S Sum.

Prerequisite: Advanced undergraduate standing

Analysis of learning units and the preparation of industrial instructional aids and devices.  
Staff

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 516 COMMUNITY OCCUPATIONAL SURVEYS

2 (2-0) S

Prerequisites: Six hours education, consent of instructor

Methods in organizing and conducting local surveys and evaluation of findings in planning a program of vocational education.  
Graduate Staff

ED 517 IMPLICATIONS FOR DATA PROCESSING IN EDUCATION

3 (3-0) F S

Prerequisites: CSC 111; ED 529 or consent of instructor

An intensive study of current attempts to apply new technologies to education. Attention will be given to research findings related to Computer Assisted Instruction, gamed instructional simulation, approaches to guidance and prescription learning as well as administrative problems pertaining to student scheduling, pupil transportation and data reporting systems.  
Graduate Staff

ED 525 TRADE ANALYSIS AND COURSE CONSTRUCTION

3 (3-0) F

Prerequisites: ED 344, PSY 304

Principles and practices in analyzing occupations for the purpose of determining teaching content. Practice in the principles underlying industrial course organization based on occupational analysis covering instruction in skills and technology and including course outlines, job sequences, the development of industrial materials and instructional schedules.  
Graduate Staff

- ED 527 PHILOSOPHY OF INDUSTRIAL AND TECHNICAL EDUCATION** 3 (3-0) F S  
 Prerequisites: ED 422, ED 440  
 A presentation of the historical development of industrial and technical education; the types of programs, philosophy, trends and problems of vocational-industrial education; study of federal and state legislation pertaining to industrial education, practical nurse education and technical education. Mr. Nerden
- ED 528 COOPERATIVE OCCUPATIONAL EDUCATION** 3 (3-0) F S  
 Prerequisites: Consent of instructor  
 This course is designed to guide and assist in the growth patterns of individuals who are preparing to be directors, administrators or supervisors of vocational education programs at the local, state and/or national levels, with special emphasis upon the organization and operation of cooperative occupational programs. The course will cover the entire field of cooperative occupational education on secondary, post-secondary and adult levels. It will refer to the accepted essentials of cooperative education in order that the application of the philosophy to the details of planning, organization, establishment, and operation of cooperative occupational programs will be practical and meaningful. Included will be student visitations to existing quality programs in cooperative occupational education, for the purpose of studying on-site conditions related to this specialized area of study. Mr. Smith
- ED 529 CURRICULUM MATERIALS DEVELOPMENT** 3 (3-0) S  
 Prerequisite: ED 525  
 Selection and organization of curricula used in vocational-industrial and technical education; development of curricula and instructional materials. Mr. Hanson
- ED 552 INDUSTRIAL ARTS IN THE ELEMENTARY SCHOOL** 3 (3-0) Sum.  
 Prerequisites: Twelve hours in education, consent of instructor  
 This course is organized to help elementary teachers and principals understand how tools, materials and industrial processes may be used to vitalize and supplement the elementary school child's experience. Practical children's projects along with the building of classroom equipment. Staff
- ED 555 COMPARATIVE CRAFTS AND INDUSTRIES** 6 Sum.  
 Prerequisites: Advanced undergraduate or graduate standing, consent of instructor  
 A travel seminar as a cultural appreciations course involving study of indigenous crafts and industries, their materials, processes, products and design in foreign countries. Mr. Olson
- ED 591 SPECIAL PROBLEMS IN INDUSTRIAL EDUCATION** Maximum 6  
 Prerequisites: Six hours graduate credit, consent of department head  
 Directed study to provide individualized study and analysis in specialized areas of trade, industrial or technical subjects. Graduate Staff
- FOR GRADUATES ONLY**
- ED 608 SUPERVISION OF VOCATIONAL AND INDUSTRIAL ARTS EDUCATION** 3 (3-0) F
- ED 609 PLANNING AND ORGANIZING TECHNICAL EDUCATION PROGRAMS** 3 (3-0) S
- ED 610 ADMINISTRATION OF VOCATIONAL AND INDUSTRIAL ARTS EDUCATION** 3 (3-0) S
- ED 611 LAWS, REGULATIONS AND POLICIES AFFECTING VOCATIONAL EDUCATION** 3 (3-0) F S

ED 612	FINANCE, ACCOUNTING AND MANAGEMENT OF VOCATIONAL EDUCATION PROGRAMS	3 (3-0) F S
ED 630	PHILOSOPHY OF INDUSTRIAL ARTS	2 (2-0) F S
ED 635	ADMINISTRATION AND SUPERVISION OF INDUSTRIAL ARTS	2 (2-0)
ED 691	SEMINAR IN INDUSTRIAL EDUCATION	1 (1-0)
ED 692	SEMINAR IN INDUSTRIAL ARTS EDUCATION	1 (1-0) F S
ED 699	RESEARCH	Credits Arranged

## INDUSTRIAL ARTS

### FOR UNDERGRADUATES

IA 100	INTRODUCTION TO INDUSTRIAL ARTS	1 (1-0) F
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A basic course designed to orient the student to college life and to introduce him to the philosophy, objectives and scope of industrial arts as related to teacher education and industrial employment. A study of the problems and opportunities in the profession.

Staff

IA 102	FUNDAMENTALS OF MATERIALS AND PROCESSES	4 (2-4) F S
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A systematic study of the structure and characteristics of selected materials and the processes utilized in shaping, forming, cutting, machining and finishing them into products. Attention will be given to the requirements of manufacturing of products. Experiences in graphic communication, demonstrations of hand and machine tools, and student participation in laboratory problems in the identification and testing of materials will be provided.

Staff

IA 103	DRAFTING I	3 (1-4) S
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Service course for agricultural education.

Graphical communication encompassing sketching and instrument drawing. Theory and practice taught through the medium of freehand sketching involving oblique, isometric, perspective, exploded, assembly, sections and orthographic projection type drawings. Also included is blackboard sketching.

Mr. Troxler

IA 105	DRAFTING	4 (2-4) F S
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Prerequisite: IA 102

This course covers theory and practice in the area of technical communication through the sketching and drafting media. The student will get practice in both sketching and instrument drawing in the orthographic projection, pictorial drawing, sections, revolutions and sheet metal development.

Mr. Troxler

IA 203	TECHNICAL SKETCHING	2 (1-2) S
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The application of drawing practices for the layman. Freehand sketching, pictorial representation, production sketches, template drawing, exploded views, shades and shadows. Individual problems and selected graphic representation.

Mr. Troxler

IA 205	INDUSTRIAL ARTS DESIGN	3 (1-4) F S
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Prerequisites: IA 100, IA 209, IA 210

A study of design as related to industry and the industrial arts laboratory. Creative design and individual expression through problems involving utilization of industrial material for human needs.

Mr. Troxler

**IA 209 WOOD PROCESSING****4 (2-4) F S****Prerequisite: IA 102**

This course is designed to provide an orientation to the processes of designing, developing and producing wood products through lectures, discussions and planned experiences in the various woodworking areas. Emphasis will be on planning and developing wood products in the industrial arts laboratory, together with an analysis of typical products and industrial practices. A research report will be required.

**Staff****IA 210 METAL TECHNOLOGY****4 (2-4) F S****Prerequisites: IA 102, IA 105**

This course is designed to provide an orientation to the process of designing, developing and producing metal products. Instruction will be given through lectures, discussions and planned experiences in the basic metal-working areas. Emphasis will be on planning and developing of metal products in the industrial arts laboratory, coupled with analysis of typical products and industrial practices. A research report will be required.

**Staff****IA 230 DRAFTING II****3 (1-4) S****Prerequisite: IA 105**

This is a depth course in drawing. The student will have laboratory exercises in problem solutions through the drawing method. The skill of application and utilization of drawing as a means of communication will be emphasized.

**Mr. Troxler****IA 304 GENERAL SHOP ORGANIZATION****2 (1-2) S****Prerequisites: IA 105, IA 209, IA 210, IA 312**

Application of principles of general shop organization and operation. Analysis of products. Methods and techniques of production of laboratory projects including a variety of materials suitable to varying educational levels.

**Mr. Young****IA 306 GRAPHIC ARTS****4 (2-4) S****Prerequisite: IA 102**

An introduction to the basic printing areas of letterpress, offset, photography, silk screen and bookbinding with emphasis on course outline and subject matter for the secondary schools.

**Mr. Bame****IA 312 ELECTRICITY-ELECTRONICS****4 (3-3) F S****Prerequisites: PY 211, PY 212 or consent of instructor**

A study of the principles of electricity and electronics, basic principles; AC and DC circuits; electrical machinery; and electronics, including power supplies, amplifiers, oscillators and tuned circuits. Applications and examples of the common experiences which the student encounters such as power and light circuits, motors and controls, measuring and servicing instruments, power supplies, amplifiers, radios and electronic control circuits.

**Mr. Young****IA 315 GENERAL CERAMICS****3 (1-4) S**

This course is designed to give the student an opportunity to work with ceramic materials as a medium of expression and to get experience in the basic manufacturing processes of the ceramic industry. Emphasis will be given to a study of the sources of clay, designing, forming, decorating and firing of ceramic products.

**Mr. Olson****FOR ADVANCED UNDERGRADUATES****IA 412 ELECTRICAL PRACTICUM****3 (1-4) S****Prerequisite: IA 312 or equivalent**

A study of design, layout and construction of basic apparatus in the fields of electricity and electronics. Special emphasis upon the use of the tools and hardware used in the electrical trades. Mr. Young

**IA 465 INDEPENDENT STUDY IN INDUSTRIAL ARTS**

Maximum 6

Prerequisite: Senior standing

A course designed to develop problem-solving ability through research activities in industrial arts. Problems in industrial arts curriculum, method and content are carefully selected, designs or plans of action are prepared, and final papers are presented and defended before a faculty committee. Staff

**IA 480 MODERN INDUSTRIES**

3 (3-0) F S

Prerequisite: Senior standing

An overview of the function and organization of modern industry. Principles of work simplification, motion economy, processing and scheduling are reviewed. The effects of technological change on labor, management, and consumer are considered. Attention will be focused on contributions of technology to specific industrial processes in machining, forming, fabricating in relationship to principles, types of equipment and usage areas. Mr. Young

**IA 484 SCHOOL SHOP PLANNING AND EQUIPMENT SELECTION**

3 (3-0) F

The physical planning of school shops and laboratories; selection of tools and equipment. Whenever possible, actual contemplated school buildings will be used for class work. Staff

## **FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**IA 510 DESIGN FOR INDUSTRIAL ARTS TEACHERS**

3 (2-2) Sum.

Prerequisites: Six hours drawing, IA 205 or equivalent

A study of new developments in the field of design with emphasis on the relationship of material and form in the selection and designing of industrial arts projects.

Graduate Staff

**IA 560 (ED 560) NEW DEVELOPMENTS IN INDUSTRIAL ARTS EDUCATION**

3 (3-0) F S

Prerequisites: Twelve hours education, teaching experience

This course is a study of the new developments in industrial arts education. It is designed to assist teachers and administrators in developing new concepts and new content based on the changes in technology. They will be required to reevaluate their programs in the light of these new concepts and the new content. Mr. Olson

**IA 590 LABORATORY PROBLEMS IN INDUSTRIAL ARTS**

Maximum 6

Prerequisites: Senior standing, consent of instructor

Courses based on individual problems and designed to give advanced majors in industrial arts education the opportunity to broaden or intensify their knowledge and abilities through investigation and research in the various fields of industrial arts, such as metals, plastics or ceramics. Graduate Staff

**IA 592 SPECIAL PROBLEMS IN INDUSTRIAL ARTS**

Maximum 6

Prerequisite: One term of student teaching or equivalent

The purpose of these courses is to broaden the subject matter experiences in the areas of industrial arts. Problems involving experimentation, investigation and research in one or more industrial arts areas will be required. Graduate Staff

**IA 595 (ED 595) INDUSTRIAL ARTS WORKSHOP**

3 (3-0) Sum.

Prerequisite: One or more years of teaching experience

A course for experienced teachers, administrators and supervisors of industrial

arts. The primary purpose will be to develop sound principles and practices for initiating, conducting and evaluating programs in this field. Enrollees will pool their knowledge and practical experiences and will do intensive research work on individual and group programs. Graduate Staff

## FOR GRADUATES ONLY

IA 645 TECHNOLOGY AND INDUSTRIAL ARTS 3 (3-0) F S

IA 660 (ED 660) INDUSTRIAL ARTS CURRICULUM 3 (3-0) F S

## INDUSTRIAL ENGINEERING

IE 241 FURNITURE MANUFACTURING PROCESSES I 3 (3-0) S  
Prerequisite: E 240

A survey of furniture manufacturing technology. Emphasis is on equipment and its relationship to furniture product engineering. Mr. Clark

IE 301 ENGINEERING ECONOMY 3 (3-0) F S  
Prerequisite: Junior standing  
Not open to students scheduling IE 311.

Criteria and techniques of engineering economy for management decisions in relation to economy of design, economy of selection and economy of operation. Study of effects of depreciation policies and machine replacement consideration. Emphasis on problem solving and development of detailed project economy studies. Staff

IE 311 ENGINEERING PROJECT ANALYSIS 3 (3-0) F S  
Prerequisite: Sophomore standing

An introduction to the organizational and production problems of industry with emphasis on the development and use of analytical methods for the evaluation of engineering alternatives. Mr. Bernhard

IE 321 BUSINESS DATA PROCESSING 3 (2-2) F S  
Prerequisite: CSC 111

The nature, flow, characteristics and handling of business data; classifying, sorting and calculating using unit record and simple business machines; collection for processing data on digital computers; information storage and retrieval, filing systems; computer programming of business problems, report generation, integration of data flows. Course will emphasize programming of several small projects and one major project on the campus computer equipment. Selection and balancing of computer systems. Mr. Llewellyn, Staff

IE 328 MANUFACTURING PROCESSES 3 (2-3) F S  
Prerequisite: MAT 201

The forming, finishing and joining operations used in the manufacture of industrial products of metallic and nonmetallic materials are treated. Principles and methods of measuring and gaging for quality assurance and for interchangeability in volume production are discussed. Laboratory work deepens the understanding of the lecture material and guides the student toward analytical thinking and reporting. Throughout the course the technical, supervisory and economic functions of the manufacturing engineer are emphasized. Mr. Kamal

IE 332 MOTION AND TIME STUDY 4 (3-3) F S  
Prerequisite: ST 361

Principles and techniques of motion and time study; detailed study of charting operator movements; micromotion study. Predetermined time data and its applica-

tions; stopwatch time study with emphasis on rating, allowances and standard data theory and practice. Mr. Anderson

IE 338 (PSY 338) HUMAN FACTORS IN EQUIPMENT DESIGN 3 (2-2) F S  
Prerequisite: IE 332 or PSY 337

An introduction to methodology in human factors research, equipment design, biomechanics, and accident study. Men's sensory, motor and decision-making abilities are related to problems of systems design, operator efficiency, and safety as these involve displays, controls, work place layout and environmental stressors. Mr. Soliday

IE 340 FURNITURE MANUFACTURING PROCESSES II 4 (2-6) F  
Prerequisites: IE 241, WPS 209

A survey of furniture manufacturing technology. Emphasis is on sequence of operations, production rates and the integration of many types of equipment into a manufacturing system. Mr. Prak

IE 341 FURNITURE PLANT LAYOUT AND DESIGN 3 (1-6) S  
Prerequisite: IE 340

Problems in industrial plant design with special reference to furniture manufacture; building structures, equipment location, space utilization, layout for operation and control; allied topics in power utilization, light, heat, ventilation and safety. Mr. Prak

IE 343 PLANT LAYOUT AND MATERIALS HANDLING 3 (1-4) F S  
Prerequisites: IE 328, IE 332

Problems in plant arrangement and layout to obtain most effective utilization of men, materials and machines as related to space and costs. Includes consideration of heat, light ventilation, organization, control, material flow and handling, working conditions, safety and other factors as they affect the most satisfactory layout of the plant. Mr. Alvarez

IE 345 PRINCIPLES OF UPHOLSTERING 2 (2-0) S  
Prerequisite: IE 241

Properties of seating equipment: evaluation of these properties. Introduction in the technology of flexible foam materials; slab foam; molded foam; stress-strain diagrams; compression set; evaluation tests. Properties of coil springs. Properties of fibrous filling materials. Upholstering constructions. Testing of upholstered furniture. Manufacturing procedures. Cost aspects. Mr. Clark

IE 346 FURNITURE DESIGN AND CONSTRUCTION 2 (2-0) S  
Prerequisite: IE 241

Lecture and laboratory work on the design and construction of modern and period furniture. The course emphasizes construction features that are economical of labor and materials and are adaptable to mass production. The course covers the use of new engineering materials and their effect on furniture construction. Mr. Prak

IE 351 PRODUCT AND PROCESS ENGINEERING 3 (2-3) F  
Prerequisite: MAT 201

A study of the selection of materials and processes required in the manufacture of component parts and assembled products. Included will be the study of the inter-relationship of product design, materials selected and processes employed in manufacturing operations. Project work will include application of basic principles in typical manufacturing processes. Capabilities and limitations of typical manufacturing equipment and processes will be stressed. Mr. Harder

IE 352 WORK ANALYSIS AND DESIGN 4 (2-6) S  
Prerequisite: A course in mathematical statistics

A study of the production processes and work methods for the purpose of improving manpower utilization, reducing human effort and reducing the costs of production. This includes techniques successfully applied in industry such as operations sequencing, operations analysis, man-machine combination, motion economy, predetermined motion standards, time study, elemental standard data, production line balancing, manufacturing progress function, lot evaluation, wage incentives and administrative functions. Mr. Anderson

**IE 353 STATISTICAL QUALITY CONTROL**

3 (3-0) F

Prerequisite: A course in mathematical statistics

An introduction to statistical techniques applied to industrial problems, including control of industrial systems, and decision-making under uncertainty. Included will be a thorough discussion of control chart techniques applied to the control of industrial processes as well as an introduction to the extension of these techniques to the control of other industrial systems. Mr. Prak

**IE 354 HUMAN FACTORS ENGINEERING**

3 (2-2) S

Corequisite: IE 352

The course is designed for industrial engineering majors. The material covers basic anatomy and physiology with emphasis on how to use this knowledge in designing equipment; systems analysis from the standpoint of the operator; the use of anthropometric data in designing equipment; and design and layout of displays, controls and work spaces. Mr. Soliday

**IE 361 QUANTITATIVE METHODS IN INDUSTRIAL ENGINEERING**

3 (3-0) F

Prerequisite: MA 301

Introduction of the mathematical tools used in the formulation and solution to problems arising in industrial engineering. Topics include linear algebra, techniques in maxima and minima and the use of Laplace and Z-transforms. Applications of these techniques will be stressed. Mr. Magazine

**IE 401 INDUSTRIAL ENGINEERING ANALYSIS I**

3 (3-0) F S

Prerequisites: IE 361 or MA 405

A study of linear programming methods and their applications in industrial engineering; the transportation method with applications to scheduling in transportation and production problems; the simplex method and its application in production planning, production scheduling and allied fields; upper bound, integer, parametric and primal-dual methods with their typical applications; the inter-relationships between linear programming and game theory. Mr. Baker

**IE 402 INDUSTRIAL ENGINEERING ANALYSIS II**

3 (3-0) F

Prerequisite: IE 401

An introductory study of several aspects of operations research methods with emphasis on their industrial engineering applications; replacement theory, sequencing problems, inventory control methods and dynamic programming and their applications. Mr. Bennington

**IE 403 INDUSTRIAL ENGINEERING ANALYSIS III**

3 (3-0) S

Prerequisite: IE 401

An introductory study of several aspects of operations research methods with emphasis on their industrial engineering applications; continuous and discrete cybernetics with emphasis on Markov processes; finite and infinite queuing models; industrial control methods and industrial dynamics. Mr. Magazine

**IE 408 PRODUCTION CONTROL**

3 (3-0) S

Prerequisites: IE 361, IE 401

Forecasting, production planning, models for scheduling and sequencing, inven-

tory models and operational systems, as well as the reporting and evaluation functions necessary for the design and control of a production system will be discussed. Application of quantitative methods to these areas of applications will be emphasized.

Mr. Bennington

**IE 420 MANUFACTURING CONTROLS**

3 (3-0) F S

Prerequisite: IE 301

Theory and methodology for developing and maintaining profitable manufacturing operations. Development of principles and procedures for control of materials, manpower and costs. Special attention to production and inventory control, equipment utilization, wage classification and cost reduction programs.

Mr. Tucker

**IE 421 DATA PROCESSING AND PRODUCTION CONTROL SYSTEMS**

3 (3-0) F S

Prerequisites: CSC 111, IE 352

This course is an introduction to the design of integrated control systems necessary for effective management of production. It will include the methods of systems design, the basic concepts of computer processing systems, the design of control procedures and reports, and their application to mechanized and electronic data processing equipment. Major emphasis will be placed on the design of control procedures for production scheduling, labor performance, quality control. Systems flow charts, block diagrams and program statements in compiler form will be used for each system application.

Mr. Llewellyn

**IE 432 STANDARD DATA**

3 (3-0) S

Prerequisite: IE 332

Theory and practice in developing standard data from measured and predetermined time data; methods of analysis and synthesis; applications of standard data in production planning and scheduling; wage incentive plans.

Mr. Kamal

**IE 440 FURNITURE MANAGEMENT ANALYSIS**

3 (1-4) F

Prerequisite: IE 341

A course in economic decision making applied to the furniture industry. The selection of equipment, materials, methods and strategy, from several feasible alternatives is studied with the aid of actual case histories.

Mr. Prak

**IE 443 QUALITY CONTROL**

3 (2-2) F S

Prerequisite: ST 361

Economic balance between cost of quality and value of quality, and techniques for accomplishing this balance. Organization for, specification and utilization of quality controls. Statistical theory and analyses as applied to sampling, control charts, tolerance determination, acceptance procedures and control of production.

Mr. Anderson

**IE 453 OPERATIONS PLANNING AND PLANT LAYOUT**

3 (2-3) F

Prerequisite: IE 352

This course will provide an opportunity for the student to apply the basic principles contained in the prerequisite courses to the design of plantwide production programs with emphasis placed on planning, arrangement layout and implementation of such programs. It will include operations sequencing, tooling and equipment selection, materials handling, systems design, manpower and facilities forecasting. Suitable cases will be drawn from both mass production and jobbing operations.

Mr. Alvarez

**IE 495 PROJECT WORK IN INDUSTRIAL ENGINEERING**

2-6 F S

Prerequisite: Senior standing

Special investigations and research related to furniture construction and processing, and other assigned problems.

Staff

**FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**IE 505 (MA 505, OR 505) MATHEMATICAL PROGRAMMING I** 3 (3-0) F Sum.  
Prerequisite: MA 405

A study of mathematical methods applied to problems of planning. Linear programming will be covered in detail. This course is intended for those who desire to study this subject in depth and detail. It provides a rigorous and complete development of the theoretical and computational aspects of this technique as well as a discussion of a number of applications. Graduate Staff

**IE 509 (OR 509) DYNAMIC PROGRAMMING** 3 (3-0) S Sum.  
Prerequisites: MA 405, ST 421

An introduction to the theory and computational aspects of dynamic programming and its application to sequential decision problems  
Messrs. Elmaghraby, Nuttle

**IE 511 ADVANCED ENGINEERING PROJECT ANALYSIS** 3 (3-0) F  
Prerequisites: IE 311, ST 421

Analysis of project economy models with certainty assumed; advantages and limitations of models, effects of income tax and depreciation methods. Risk analyses employing probability concepts; sensitivity studies and measure of utility. Estimation techniques and use of accounting information, time series analysis and judgment factors. Planning and uses of capital funds. Mr. Bernhard

**IE 515 PROCESS ENGINEERING** 3 (3-0) F  
Prerequisites: IE 328, IE 443

The technical processes of translating product design into a manufacturing program. The application of industrial engineering in the layout, tooling, methods, standards, costs and control functions of manufacturing. Laboratory problems covering producer and consumer products. Mr. Harder

**IE 517 AUTOMATIC PROCESSES** 3 (3-0) S  
Prerequisites: IE 328, IE 443

Principles and methods for automatic processing. The design of product, process and controls. Economic, physical and sociological effects of automation. Mr. Harder

**IE 521 CONTROL SYSTEMS AND DATA PROCESSING** 3 (3-0) S  
Prerequisite: IE 421

This course is designed to train the student in the problems and techniques required for systematic control of the production process and the business enterprise. This includes training in the determination of control factors, the collection and recording of data, and the processing, evaluation and use of data. The course will illustrate the applications and use of data processing equipment and information machines in industrial processes. Case problems will be used extensively. Mr. Llewellyn

**IE 522 (OR 522) DYNAMICS OF INDUSTRIAL SYSTEMS** 3 (3-0) F  
Prerequisite: IE 421

A study of the dynamic properties of industrial systems; introduction of servomechanism theory as applied to company operations. Simulation of large nonlinear, multiloop, stochastic systems on a digital computer; methods of determining modifications in systems design and/or operating parameters for improved system behavior. Mr. Llewellyn

**IE 523 INVENTORY CONTROL METHODS I** 3 (3-0) S  
Prerequisites: OR 501, ST 421, or ST 515

A study of inventory policy with respect to reorder sizes, minimum points and production schedules. Simple inventory models, models with restrictions, price breaks, price changes, analysis of slow-moving inventories. Introduction to the smoothing problem in continuous manufacturing. Applications of linear and dynamic programming.

Mr. Alvarez

**IE 540 (PSY 540) HUMAN FACTORS IN SYSTEMS DESIGN**

3 (3-0) F

Prerequisites: ST 513 or ST 515, IE 338 (PSY 338), IE 441 or consent of instructor

Introduction to problems of the systems development cycle, including man-machine function allocation, military specifications, display-control compatibility, the personnel subsystem concept and maintainability design. Detailed treatment is given to man as an information processing mechanism.

Mr. Pearson

**IE 541 RESEARCH METHODS IN ACCIDENT STUDY**

3 (2-2) F

Prerequisites: IE 338 (PSY 338), ST 421

Consideration of the methods used in accident-injury study, including field investigation, experimental engineering and biomedical research, statistical studies, and computer simulation. (Offered in alternate years.)

Mr. Ayoub

**IE 542 PHYSIOLOGICAL CRITERIA IN WORK MEASUREMENT**

3 (3-0) F

Prerequisite: Graduate standing

The course first provides the student with a background of physiological knowledge appropriate to the study of men at work. It then covers application of this knowledge of the study of equipment design and its use.

Mr. Soliday

**IE 546 ADVANCED QUALITY CONTROL**

3 (3-0) S

Prerequisites: IE 353, ST 421

The statistical foundations of quality control are emphasized in this course as well as its economic implications. Mathematical derivations of most of the formulae used are given. Sampling techniques are treated extensively and many applications of this powerful technique are explained.

Graduate Staff

**IE 547 ENGINEERING RELIABILITY**

3 (3-0) F

Prerequisites: IE 353, ST 421

The methodology of reliability including application of discrete and continuous distribution models and statistical designs; reliability estimation, reliability structure models, reliability demonstration and decisions, and reliability growth models. Examples of reliability evaluation and demonstration programs.

Graduate Staff

**IE 561 (OR 561) QUEUES AND STOCHASTIC SERVICE SYSTEMS**

3 (3-0) F

Prerequisite: MA 421

General concepts of stochastic processes are introduced. Poisson processes, Markov processes and renewal theory are presented. These are then used in the analysis of queues, starting with a completely memoryless queue to one with general parameters. Applications to many engineering problems will be considered.

Mr. Magazine

**IE 586 (OR 586) NETWORK FLOWS**

3 (3-0) S

Prerequisite: IE 505 (MA 505, OR 505) or equivalent

This course will study problems of flows in networks. These problems will include the determination of the shortest chain, maximal flow and minimal cost flow in networks. The relationship between network flows and linear programming will be developed as well as problems with nonlinear cost functions, multi-commodity flows and the problem of network synthesis. (Offered in alternate years.)

Mr. Bennington

<b>IE 591 PROJECT WORK</b>	<b>2-6 F S</b>
<b>Prerequisite:</b> Graduate or senior standing	
Investigation and report on an assigned problem for students enrolled in the fifth-year curriculum in industrial engineering.	
	Graduate Staff

**FOR GRADUATES ONLY**

IE 608 LINEAR PROGRAMMING APPLICATIONS	3 (3-0) S
IE 611 THE DESIGN OF PRODUCTION SYSTEMS (Alternate years.)	3 (3-0) F
IE 622 INVENTORY CONTROL METHODS II	3 (3-0) F
IE 640 (PSY 640) SKILLED OPERATOR PERFORMANCE	3 (3-0) S
IE 641 ENVIRONMENTAL FACTORS AND HUMAN PERFORMANCE	3 (3-0) S
IE 651 SPECIAL STUDIES IN INDUSTRIAL ENGINEERING	Credits Arranged
IE 692 (MA 692, OR 692) SPECIAL TOPICS IN MATHEMATICAL PROGRAMMING	3 (3-0) F S Sum.
IE 693 SEMINAR IN SYSTEMS SAFETY ENGINEERING	1 (1-0) S
IE 694 ADVANCED PROBLEMS IN HUMAN FACTORS ENGINEERING	3 (3-0) S
IE 695 SEMINAR	1 (1-0) F S
IE 699 INDUSTRIAL ENGINEERING RESEARCH	Credits Arranged

**INTERNATIONAL STUDENT ORIENTATION**

ISO 100 INTERNATIONAL STUDENT ORIENTATION	1 (1-0) F S
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An orientation course required of all foreign students, new to the United States, which serves to acquaint them with the Raleigh community, American culture, University academic procedures and U.S. Government regulations. Undergraduates should enroll for credit and graduates for audit.

Mr. Weaver

**LANDSCAPE ARCHITECTURE**

LAR 211 INTRODUCTION TO LANDSCAPE ARCHITECTURE	3 (3-0) F S
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A survey course of the profession of landscape architecture for majors in the related fields of recreation resources administration, civil engineering, forestry and horticultural sciences, including the function, responsibilities and training of the landscape architect; the design process (criteria, approaches, sequence); office procedures and practices; formulation, presentation and interpretation of contract documents; and the relationships of landscape architecture to related fields.

Staff

LAR 312 SITE PLANNING	3 (1-6) S
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**Prerequisite:** Junior standing

The course is an introduction into the problems of small scale design and technical operations such as grading, alignment, controls will be covered.

Staff

**LAR 321, 322 LANDSCAPE MATERIALS I, II****3 (1-4) F S****Prerequisite:** Science electives

A professional option for those students wishing to concentrate on small scale physical design. The course will cover identification and properties of materials. Exercises in design will stress implementation and use of materials for particular situations. **Staff**

**LAR 400 INTERMEDIATE LANDSCAPE ARCHITECTURE DESIGN (SERIES)****4 (1-9) F S****Prerequisite:** DN 202 or equivalent or consent of department

The LAR 400 Series is intended to permit students a flexibility in scheduling. The courses will cover small scale design, urban landscape architecture, public and institutional design. Each course will be conducted as a workshop/studio to study the problems of project organization, design and execution. The course may be scheduled four times. **Staff**

**LAR 411, 412 LANDSCAPE TECHNOLOGY****3 (1-6) F S****Prerequisite:** Junior standing

Techniques and procedures of construction drawing. Contracts, specifications and office practices. Consolidation of previous technical course work by case study projects of various scales. **Staff**

**LAR 491 SPECIAL PROJECTS IN LANDSCAPE ARCHITECTURE****2-4 F S****Prerequisites:** Senior standing and 3.0 G.P.A.

The course is intended as a special projects framework for advanced undergraduates to do research on a tutorial basis. The course may be scheduled two times. **Staff**

**FOR GRADUATES AND ADVANCED UNDERGRADUATES****LAR 501, 502 LANDSCAPE DESIGN I, II****6 (3-9) F S****Prerequisite:** Graduate standing

Regional research and analysis. Social criteria of urban and regional design. Transportation systems, land use determination and the design of large scale environmental complexes. Open to graduate students in related fields. Evaluation of nonmajors based on contribution of their discipline to group effort. (Not available after spring 1973.) **Staff**

**LAE 503 REGIONAL DESIGN WORKSHOP I****3 (0-9) F S****Prerequisite:** Graduate standing

Study of current literature in regional design and planning with emphasis on extracting a number of premises, theoretical structures and information handling techniques as a basis for seminar discussions and activities. **Staff**

**LAR 504 REGIONAL DESIGN WORKSHOP II****3 (0-9) F S****Prerequisite:** Graduate standing

Case study projects designed to explore the relationship between the resource base and the development intentions with the purpose of evolving clear statements or problems involved and their susceptibility to solution problem situations will be developed from differing viewpoints and levels of complexity. **Staff**

**LAR 512 PHYSICAL SYSTEMS****3 (2-2) S****Prerequisite:** Consent of instructor

Analysis of physical systems and methods of determining relationships between systems with particular reference to natural systems, managed resource systems, development systems and their relationship to development objectives. **Staff**

**LAR 521 INTRODUCTION TO REGIONAL DESIGN** 3 (2-2) F  
 Prerequisite: Consent of instructor

A perspective of the measures man has taken to ensure his relation to the general environment. Ecologic determinism, economic and political functionalism and aesthetic movements will be developed in an historical context. Staff

**LAR 591, 592 SPECIAL PROJECTS** 4 (2-6) F S  
 Prerequisite: Graduate standing

Student-evolved projects with emphasis on utilization and expansion of technical processes and techniques to reinforce design solutions. Introduction and investigation of experimental methodology. Development of student-evolved interest in specific areas. Open to graduate students in related fields. Evaluation of nonmajors based on contribution of their discipline to group effort. Staff

## FOR GRADUATES ONLY

**LAR 603 REGIONAL DESIGN III** 3 (0-9) F

**LAR 604 REGIONAL DESIGN IV** 3-6 S

**LAR 611 PHYSICAL DESIGN POLICY** 3 (2-2) F S

**LAR 691 DEGREE SEMINAR** 0

## MARINE SCIENCES

### FOR ADVANCED UNDERGRADUATES

**MAS 200 (OY 200) INTRODUCTION TO THE MARINE ENVIRONMENT** 3 (3-0) F S  
 Prerequisite: High school physics, chemistry, algebra, trigonometry and biology or equivalent

A descriptive account of the ocean as a part of our environment; subjects covered include interactions between atmosphere and ocean, ocean circulation, physical and chemical properties of sea water, marine geology and marine biology.

**MAS 471 (MAE 471) UNDERSEA VEHICLE DESIGN** 3 (3-0) F S  
 (See mechanical and aerospace engineering, page 392.)

**MAS 487 (CE 487, OY 487) PHYSICAL OCEANOGRAPHY** 3 (3-0) S  
 (See physical oceanography, page 420.)

### FOR GRADUATES AND ADVANCED UNDERGRADUATES

**MAS 529 (ZO 529) BIOLOGICAL OCEANOGRAPHY** 3 (3-0) S  
 (See zoology, page 483.)

**MAS 541 (OY 541, CE 541) GRAVITY WAVE THEORY I** 3 (3-0) S  
 Prerequisite: EM 303 or PY 411

Classical gravity wave theory with emphasis on the basic mechanics of wave motions, mass transport induced by waves and various conservation laws with their applications in wave study.

**MAS 551 (OY 551) OCEAN CIRCULATION** 3 (3-0) S  
 Prerequisite: EM 303 or PY 411

Basic study of the mechanics of ocean circulation with emphasis on various simple models of circulation systems.

MAS 581 (CE 581) INTRODUCTION TO OCEANOGRAPHIC ENGINEERING 3 (3-0) F  
(See civil engineering, page 283.)

MAS 584 (GY 584) MARINE GEOLOGY 3 (3-0) S  
(See geology, page 346.)

MAS 591, 592 MARINE SCIENCES SEMINAR 1 (1-0) F S

A seminar designed to give perspective in the field of oceanology; topics vary from semester to semester. In order to obtain credit a student must deliver a seminar.

## FOR GRADUATES ONLY

MAS 601 (OY 601) ADVANCED PHYSICAL OCEANOGRAPHY I 3 (3-0) F

MAS 602 (OY 602) ADVANCED PHYSICAL OCEANOGRAPHY II 3 (3-0) S

MAS 605 (OY 605, EM 605) ADVANCED GEOPHYSICAL FLUID MECHANICS I 3 (3-0) F

MAS 606 (OY 606 EM 606) ADVANCED GEOPHYSICAL FLUID MECHANICS II 3 (3-0) S

MAS 613 (OY 613, EM 613) PERTURBATION METHOD IN FLUID MECHANICS I 3 (3-0) F

MAS 614 (OY 614, EM 614) PERTURBATION METHOD IN FLUID MECHANICS II 3 (3-0) S

MAS 693 SPECIAL TOPICS IN MARINE SCIENCES 1-3

## MATERIALS ENGINEERING

### FOR UNDERGRADUATES

MAT 200 MECHANICAL PROPERTIES OF STRUCTURAL MATERIALS 2 (1-3)  
Prerequisites: CH 105 and the first course in engineering mechanics

The dependence of mechanical properties of structural materials on macro-, micro- and crystalline structure; control of structure through treatment.

MAT 201 STRUCTURE AND PROPERTIES OF ENGINEERING MATERIALS I 3 (2-3)  
Prerequisite: CH 105

An introduction to the fundamental physical principles governing the structure and constitution of metallic and nonmetallic materials of construction, and the relation of these principles to the control of properties.

MAT 301 EQUILIBRIUM AND RATE PROCESSES IN MATERIALS SCIENCE 3 (3-0)  
Prerequisite: CH 331 or equivalent

Application of thermodynamic and kinetic principles to engineering materials in the liquid and solid states.

MAT 310 PHYSICAL EXAMINATION OF MATERIALS 3 (1-6)  
Prerequisite: MAT 201

Experiments designed to demonstrate basic techniques in crystallography. X-ray diffraction, optical and electron microscopy.

**MAT 311 CERAMIC PROCESSING I**

4 (3-3)

**Prerequisite:** MAT 201

A detailed study covering the basic chemical and physical laws underlying the processes and behavior of diverse ceramic compositions in the sequential manufacturing operations required to produce ceramic materials with controlled properties. Included are such topics as size reduction, separation and analysis; particle packing, mixing, agglomeration, surface chemistry, rheology of liquid-solid and solid-polymer systems; and behavior of ceramics in a wide variety of forming processes.

**MAT 312 CERAMIC PROCESSING II**

3 (3-0)

**Prerequisite:** MAT 311

Basic principles underlying the thermal processing of ceramics are covered. Appropriate subject material in basic and engineering sciences are included. Particular reference is made to obtaining desired microstructures. Included are such topics as fuels; combustion and heat sources; heat transfer and heat utilization; gas and liquid flow relation; psychrometry and drying; high temperature processing such as calcining; sintering in the presence and absence of liquid phases, melting and hot forming; and supplementary finishing processes after firing of the ceramic.

**MAT 401 MATERIALS PROCESSING**

3 (3-0)

**Prerequisite:** MAT 301, MAT 450, MAT 412

Techniques for the processing of ceramic, metallic, and polymeric materials to control properties, form, and appearance through considerations of thermal, chemical, mechanical, electrical, magnetic and nuclear energy. Both traditional and exotic processes are covered utilizing fundamental materials science and engineering science principles.

**MAT 411, 412 PHYSICAL PRINCIPLES IN MATERIALS SCIENCE I, II**

3 (3-0)

**Prerequisites:** (411) MAT 201; (412) MAT 411

Introduction to the fundamental physical concepts of ceramic, metallic and polymeric materials. Relation between properties and structure.

**MAT 417 CERAMIC SUBSYSTEM DESIGN**

3 (2-3)

**Prerequisite:** MAT 312

Individual and team study involving the interdependence of plant layout, processes, equipment and materials in the economic design of engineering systems and subsystems. Discussion of design principles, sources of data, creativity and economic analysis to encourage original solutions to problems of current and future need and interest in the ceramic profession.

**MAT 423, 424 MATERIALS FACTORS IN DESIGN I, II**

3 (3-0)

**Prerequisites:** (423) MAT 450; (424) MAT 423**Corequisite:** (423) MAT 431

Selection of materials for specific engineering applications. Manufacturing processes and their relation to product use.

**MAT 431, 432 PHYSICAL METALLURGY I, II**

3 (3-0)

**Prerequisites:** (431) MAT 412; (432) MAT 431

Alloy design; control of properties through microstructures; principles of heat treatment; strengthening mechanisms.

**MAT 435, 436 PHYSICAL CERAMICS I, II**

(435) 3 (3-0)

**Prerequisites:** (435) MAT 412; (436) MAT 435

(436) 3 (2-3)

A project-oriented course in which starting materials of various types of ceramic products are characterized including analysis of reactions, selection of pro-

cessing parameters, processing, measurement and properties appropriate to the ceramic analysis; and correlation of all materials and processing parameters with properties and microstructures. Projects are selected to exemplify characteristic types of ceramics.

**MAT 437 INTRODUCTION TO THE VITREOUS STATE**

3 (3-0)

Prerequisites: MAT 301

An introductory study of the vitreous state to include the structure, properties and type of glasses (including glazes and enamels). Opacity color and devitrification. Nature of the glassy phase in kiln-fired ceramics.

**MAT 450 MECHANICAL PROPERTIES OF MATERIALS**

3 (3-0)

Prerequisites: MAT 201 and EM 205

Elastic, plastic, and fracture phenomena in solids including yielding, strain hardening, brittle fracture, creep and fatigue.

**MAT 491 MATERIALS ENGINEERING SEMINAR**

1 (1-0)

Prerequisite: Senior standing

Literature survey of selected topics in materials engineering. Oral and written reports and discussions.

**MAT 493, 494 CERAMIC FIELD EXERCISES I, II**

1 (0-3)

Prerequisite: Senior standing

Selected plant visitations, lectures by practicing ceramic engineers, reports on industrial organizations engaged in manufacture or use of ceramics. Discussions of professional organizations and professional ethics.

**MAT 495, 496 EXPERIMENTAL ENGINEERING I, II**

3 (1-6)

Prerequisite: Senior standing

Advanced engineering principles applied to a specific project dealing with metallurgy, materials or general experimental work. A seminar period is provided and a written report required.

## **FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**MAT 500 MODERN CONCEPTS IN MATERIALS SCIENCE**

3 (3-0) F

Prerequisite: MAT 412

Applications of current theories of materials such as crystal theory, continuum and quasi-continuum theories, phenomenological theories, etc., to the solution of materials problems.

**MAT 503 CERAMIC MICROSCOPY**

3 (2-3) F

Prerequisite: GY 331

Transmitted and reflected light techniques for the systematic study of ceramic materials and products.

**MAT 509 HIGH VACUUM TECHNOLOGY**

3 (2-3) Sum.

Prerequisite: CH 433 or MAE 301

Properties of low-pressure gases and vapors. Production, maintenance and measurement of high vacuum; design, construction and operation of high vacuum high temperature facilities. Properties and reactions of materials which are processed, tested and/or utilized in high vacuum environments.

**MAT 510 STRUCTURE OF CRYSTALLINE MATERIALS**

3 (3-0) F

Prerequisite: MAT 411

Corequisite: MAT 500

The lattice structure of crystals, including group theory applications, reciprocal lattice concept and the study of crystal structure as related to bonding.

**MAT 520 THEORY AND STRUCTURE OF MATERIALS** 3 (3-0) F  
Prerequisite: MAT 510

Structure of liquids, and crystalline and amorphous solids used in engineering systems. Crystallinity and thermal properties. Ionic crystals in ceramic systems. The metallic state and alloy behavior. Emphasis is placed on the relation between fundamental materials parameters and engineering properties.

**MAT 527 REFRACTORIES IN SERVICE** 3 (3-0) S  
Prerequisite: MAT 411

A study of the physical and chemical properties of the more important refractories in respect to their environment in industrial and laboratory furnaces.

**MAT 529 PROPERTIES OF HIGH TEMPERATURE MATERIALS** 3 (3-0) S  
Prerequisite: MAT 201

Effects of temperature on the physical, mechanical and chemical properties of inorganic materials; relationships between microstructure and high temperature properties; applications of ceramics, metals and composites at elevated temperatures.

**MAT 530 PHASE TRANSFORMATION IN MATERIALS I** 3 (3-0) F  
Corequisite: MAT 500

Kinetic theory of transformations, nucleation theory, homogenous and heterogeneous nucleation, growth of crystals, epitaxial thin films.

**MAT 533, 534 ADVANCED CERAMIC ENGINEERING DESIGN I, II** 3 (2-3) F S  
Prerequisite: MAT 417

Advanced studies in analysis and design of ceramic products, processes and systems leading to original solutions of current industrial problems and the development of new concepts of manufacturing.

**MAT 540 GLASS TECHNOLOGY** 3 (3-0) F  
Prerequisite: MAT 437

Fundamentals of glass manufacture including compositions, properties and application of the principal types of commercial glasses.

**MAT 541, 542 PRINCIPLES OF CORROSION I, II** 3 (2-3) F S  
Prerequisite: MAT 431 or CH 431

The fundamentals of metallic corrosion and passivity. The electro-chemical nature of corrosive attack, basic forms of corrosion, corrosion rate factors, methods of corrosion protection. Laboratory work included.

**MAT 550 DISLOCATION THEORY** 3 (3-0) F  
Prerequisite: MAT 450

Structure, energetics, stress and strain fields, interactions and motion of dislocations in solids.

**MAT 556 COMPOSITE MATERIALS** 3 (3-0) F  
Prerequisite: MAT 450

Basic principles underlying the properties of composite materials as related to properties of the individual constituents and their interaction. Emphasis is placed on the design of composite systems to yield desired combinations of properties.

**MAT 562 (NE 562) MATERIALS PROBLEMS IN NUCLEAR ENGINEERING** 3 (3-0) F  
Prerequisite: PY 410 or consent of instructor

Reactor component design considerations determined by materials properties as well as by nuclear function are covered. Emphasis is placed on radiation effects and other concepts pertinent to the selection of materials for nuclear reactors for either terrestrial or space applications.

MAT 573 (NE 573) COMPUTER EXPERIMENTS IN MATERIALS  
ENGINEERING

3 (3-0) F

Prerequisites: PY 407, MA 301

The basic techniques for constructing both statistical (Monte Carlo) and deterministic computer experiments will be explained and discussed from the standpoint of immediate use in the solution of current engineering research and development problems.

MAT 595, 596 ADVANCED MATERIALS EXPERIMENTS I, II

3 (1-6) F S

Prerequisite: MAT 411

Advanced engineering principles applied to a specific experimental project dealing with materials. A seminar period is provided and a written report is required.

## FOR GRADUATES ONLY

MAT 601 CERAMIC PHASE RELATIONSHIPS

3 (3-0) S

MAT 603 ADVANCED CERAMIC REACTION KINETICS

3 (3-0) S

MAT 610 X-RAY DIFFRACTION

3 (3-0) F

MAT 615 ELECTRON MICROSCOPY

3 (3-0) F

MAT 621 THEORY AND STRUCTURE OF AMORPHOUS MATERIALS

3 (3-0) S

MAT 622 THEORY AND STRUCTURE OF CERAMIC MATERIALS

3 (3-0) F

MAT 623 THEORY AND STRUCTURE OF METALLIC MATERIALS

3 (3-0) F

MAT 630 PHASE TRANSFORMATION IN MATERIALS II

3 (3-0) F

MAT 631, 632 ADVANCED PHYSICAL CERAMICS I, II

3 (2-3) F S

MAT 633 ADVANCED MECHANICAL PROPERTIES OF MATERIALS

3 (3-0) F

MAT 661 DIFFRACTION THEORY

3 (3-0) F

MAT 691, 692 SPECIAL TOPICS IN MATERIALS ENGINEERING

3 (3-0) F S

MAT 695 MATERIALS ENGINEERING SEMINAR

1 (1-0) F S

MAT 699 MATERIALS ENGINEERING RESEARCH

Credits Arranged

## MATHEMATICS

MA 102 ANALYTIC GEOMETRY AND CALCULUS I

4 (3-2) F S

Prerequisite: MA 111 or equivalent completed in high school

Credit in both MA 102 and MA 112 is not allowed.

The first of three semesters of a unified course in analytic geometry and calculus. Functions and graphs, limits, derivatives of algebraic functions and applications,

indefinite integral, definite integral and the fundamental theorem of calculus, areas and volumes, plane analytic geometry.

**MA 111 ALGEBRA AND TRIGONOMETRY**

4 (3-2) F S

Sets, and logic, the real number system, polynomials, algebraic fractions, exponents and radicals, linear and quadratic equations, inequalities, functions and relations, logarithms, plane trigonometry. (Students in the Schools of Engineering, Physical and Mathematical Sciences, Design and Departments of Agricultural Engineering and Mathematics Education who may be required to take this course will not receive credit hours for MA 111 toward the graduation requirements).

**MA 112 ANALYTIC GEOMETRY AND CALCULUS A**

4 (4-0) F S

Prerequisite: MA 111

Credit in both MA 102 and MA 112 is not allowed.

Limits and derivatives, techniques of differentiation, applications, logarithmic and exponential functions, higher derivatives, definite integral, applications, integration techniques, multivariate calculus, partial derivatives, multiple integrals, examples and applications in biological and behavioral sciences.

**MA 114 TOPICS IN MODERN MATHEMATICS**

3 (3-0) F S

Prerequisite: MA 111 or equivalent completed in high school

Addition and multiplication of matrices, linear equations, linear dependence and vector space, linear inequalities and linear programming, binary relations, eigenvalues, quadratic forms, finite Markov chains, examples and applications in biological and behavioral sciences.

**MA 115 INTRODUCTION TO CONTEMPORARY MATHEMATICS I**

3 (3-0) F S

Credit in MA 115 is not allowed if the student already has credit in MA 102, MA 112 or MA 114.

The number system and other scales of notation; algebraic operations, inequalities; sets, logic and Boolean algebra; logarithmic and trigonometric functions. The point of view is intuitive. Some emphasis is placed on the history of certain mathematical concepts and on the importance of mathematics in contemporary life.

**MA 116 INTRODUCTION TO CONTEMPORARY MATHEMATICS II**

3 (3-0) F S

Prerequisite: MA 115

Credit in MA 116 is not allowed if student already has credit in MA 201, MA 112 or MA 114.

Permutations, combinations and the binomial theorem; probability; mathematical induction, the group as an example of a finite mathematical system; graphs of systems of linear inequalities and linear programming; solutions of linear systems by Cramer's rule and by matrix methods; introduction to analytic geometry and calculus.

**MA 122 MATHEMATICS OF FINANCE AND ELEMENTARY STATISTICS**

4 (3-2) F S

Prerequisite: MA 111 or MA 115

Simple and compound interest, annuities and their application to amortization and sinking fund problems, installment buying, calculation of premiums of life annuities and life insurance, elementary statistics.

**MA 127 RECREATIONAL MATHEMATICS**

3 (3-0) S

Prerequisite: MA 111 or MA 115

Covers traditional subject matter of recreational mathematics with an eye to introducing mathematical concepts. Requires only algebra and trigonometry, but student must be willing to engage in new types of mathematical thought. Topics include games and puzzles, problems, tricks, geometric figures, model building, fallacies, paradoxes, curiosities, anecdotes, conjectures, famous problems, mathemat-

ical humor, and more. Mathematical treatments will involve number theory, set theory, algebra, topology, combinatorics, geometry, probability, analysis, computer science and math history.

**MA 201 ANALYTIC GEOMETRY AND CALCULUS II** 4 (4-0) F S  
Prerequisite: MA 102

The second of three semesters of a unified course in analytic geometry and calculus. Applications of the definite integral. Transcendental functions, methods of integration, polar coordinates, parametric equations, introduction to infinite series.

**MA 202 ANALYTIC GEOMETRY AND CALCULUS III** 4 (4-0) F S  
Prerequisite: MA 201

The third of three semesters of a unified course in analytic geometry and calculus. Brief introduction to determinants and matrices, vector functions, analytic geometry of three dimensions and partial differentiation, multiple integration, applications. Line integral and Green's Theorem.

**MA 212 ANALYTIC GEOMETRY AND CALCULUS B** 3 (3-0) F S  
Prerequisite: MA 112

Sequences, series, Taylor's Theorem, trigonometric functions, difference equations, differential equations, examples and applications in biological and behavioral sciences.

**MA 214 ELEMENTARY PROBABILITY** 3 (3-0) S  
Prerequisite: MA 112 or MA 102

Basic concepts, elementary counting procedures, conditional probability, discrete random variables, infinite sample spaces, continuous random variables, continuous time stochastic processes, examples and applications in biological and behavioral sciences.

**MA 231 INTRODUCTION TO LINEAR ALGEBRA** 3 (3-0) F S  
Prerequisite: MA 201

Vectors and vector spaces, linear transformations, linear equations, determinants, eigenvalues and quadratic forms.

**MA 232 INTRODUCTION TO MULTIVARIABLE CALCULUS** 3 (3-0) F S  
Prerequisite: MA 231

Functions of several variables, limits, continuity, differentiability, chain rule, implicit functions, multiple integrals.

**MA 301 APPLIED DIFFERENTIAL EQUATIONS I** 3 (3-0) F S  
Prerequisite: MA 202 or equivalent

First order equations, applications, linear equations of higher order, applications to mechanical and electrical systems, series solutions, special functions, Laplace transforms.

**MA 312 INTRODUCTION TO DIFFERENTIAL EQUATIONS** 3 (3-0) F S  
Prerequisite: MA 231, MA 201

First order differential equations, basic theory and application of linear equations. Systems of linear equations, matrix methods, series solutions, Laplace transforms, existence and uniqueness.

**MA 381 SPECIAL TOPICS** 1-6 F S  
Prerequisite: Consent of department

This course will be used to develop unusual or new mathematics courses for the needs of students in any curriculum.

## FOR ADVANCED UNDERGRADUATES

**MA 401 APPLIED DIFFERENTIAL EQUATIONS II** 3 (3-0) F S  
Prerequisite: MA 301 or MA 312

The wave, heat and Laplace equations. Solutions by separation of variables and expansion in Fourier Series or other appropriate orthogonal sets.

**MA 403 INTRODUCTION TO MODERN ALGEBRA** 3 (3-0) F S  
Prerequisite: One year of calculus

Sets and mappings; equivalence relations; groups, homomorphisms, cosets, Cayley's theorem, symmetric groups, quotient groups, rings, integral domains; Euclidean algorithm, polynomial rings, ideals, quotient rings.

**MA 404 AFFINE AND PROJECTIVE GEOMETRIES** 3 (3-0) S  
Prerequisites: MA 231 and MA 403

An introduction to the geometry of euclidean, affine and projective spaces with special emphasis on the important groups of symmetries of these spaces.

**MA 405 INTRODUCTION TO MATRICES AND LINEAR TRANSFORMATIONS** 3 (3-0) F S  
Prerequisite: One year of calculus

Determinants, linear equations, linear transformations and matrices, operations with matrices, eigenvalues, introduction to bilinear and quadratic forms.

**MA 408 FOUNDATIONS OF EUCLIDEAN GEOMETRY** 3 (3-0) F  
Prerequisite: MA 403

A critique of Euclid's Elements, incidence and order properties, congruence of triangles, absolute and non-Euclidean geometry, the parallel postulate, real numbers and geometry.

**MA 410 THEORY OF NUMBERS** 3 (3-0) F S  
Prerequisite: One year of calculus

This course is concerned with the investigation of the arithmetic properties of the integers. Topics include congruences, arithmetic functions, quadratic residues, the quadratic reciprocity Law of Gauss, primitive roots, diophantine equations, and algebraic number fields.

**MA 421 INTRODUCTION TO PROBABILITY** 3 (3-0) F S  
Prerequisite: One year of calculus

Axioms of probability, conditional probability, combinatorial analysis, random variables, expectation, simple stochastic processes.

**MA 425 MATHEMATICAL ANALYSIS I** 3 (3-0) F  
Prerequisite: MA 232

Real number system, functions and limits, topology on the real line, continuity, differential and integral calculus for functions of one variable.

**MA 426 MATHEMATICAL ANALYSIS II** 3 (3-0) S  
Prerequisite: MA 425

Infinite series, uniform convergence, calculus of several variables, topology in n-dimensions, limits, continuity, differentiability, implicit functions, multiple integrals, line and surface integrals.

**MA 430 INTRODUCTION TO APPLIED MATHEMATICS** 3 (3-0) F  
Prerequisites: MA 426, MA 421, or MA 214

Formulation of scientific problems in mathematics terms, interpretation and evaluation of the solutions. Topics discussed will be chosen from problems in mana-

gerial, behavior and life sciences as well as the physical sciences.

**MA 433 HISTORY OF MATHEMATICS** 3 (3-0) S  
Prerequisite: One year of calculus

Evolution of the number system, trends in the development of modern mathematics; lives and contributions of outstanding mathematicians.

**MA 491 READING IN HONORS MATHEMATICS** 2-6 F S  
Prerequisites: Membership in honors program, consent of department

**MA 493 SPECIAL TOPICS IN MATHEMATICS** 1-6 F S  
Prerequisite: Consent of department

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

**MA 504 (NE 504) MATHEMATICAL METHODS IN ENGINEERING** 3 (3-0) F  
Prerequisite: MA 301 or MA 312

Survey of mathematical methods for engineers. Topics include ordinary differential equation matrices, partial differential equations, difference equations, numerical methods, elements of statistics. Techniques and applications to engineering are stressed. This course cannot be taken for credit by mathematics majors.

**MA 505 (IE 505, OR 505) MATHEMATICAL PROGRAMMING I** 3 (3-0) F Sum.  
(See industrial engineering, page 369.)

**MA 511 ADVANCED CALCULUS I** 3 (3-0) F S  
Prerequisite: MA 301 or MA 312

Fundamental theorem on continuous functions; convergence theory of sequences, series and integrals; the Riemann integral.

**MA 512 ADVANCED CALCULUS II** 3 (3-0) F S  
Prerequisite: MA 301 or MA 312

General theorems of partial differentiation; implicit function theorems; vector calculus in 3-space; line and surface integrals; classical integral theorems.

**MA 513 INTRODUCTION TO COMPLEX VARIABLES** 3 (3-0) F S  
Prerequisite: MA 511 or MA 425

Operations with complex numbers, derivatives, analytic functions, integrals, definitions and properties of elementary functions, multivalued functions, power series, residue theory and applications, conformal mapping.

**MA 514 METHODS OF APPLIED MATHEMATICS** 3 (3-0) S  
Prerequisite: MA 511 or MA 425

Introduction to integral equations, the calculus of variations and difference equations.

**MA 515 LINEAR FUNCTIONAL ANALYSIS I** 3 (3-0) F  
Prerequisite: MA 426

Metric spaces, Lebesgue measure and integration;  $L^p$  and  $l^p$  spaces; Riesz-Fischer and Riesz representation theorems; normed linear spaces and Hilbert spaces.

**MA 516 LINEAR FUNCTIONAL ANALYSIS II** 3 (3-0) S  
Prerequisite: MA 515

Basic theorems in Banach spaces, dual spaces, weak topologies; basic theorems in Hilbert spaces, and detailed theory of linear operators on Hilbert spaces; spectral theorem for self-adjoint completely continuous linear operators.

MA 517 INTRODUCTION TO TOPOLOGY 3 (3-0) F S

Prerequisite: MA 426

Sets and functions, metric spaces, topological spaces, compactness, separation, connectedness.

MA 518 CALCULUS ON MANIFOLDS 3 (3-0) S

Prerequisite: MA 426

Calculus of several variables from a modern viewpoint. Differential and integral calculus of several variables, vector functions, integration on manifolds, Stoke's and Green's theorems, vector analysis.

MA 520 LINEAR ALGEBRA 3 (3-0) F S

Prerequisite: MA 231 or MA 405

Vector spaces, linear mappings and matrices, determinants, inner product spaces, bilinear and quadratic forms, canonical forms, spectral theorem.

MA 521 FUNDAMENTALS OF MODERN ALGEBRA 3 (3-0) S

Prerequisite: MA 403

Groups, normal subgroups, quotient groups, Cayley's theorem, Sylow's theorem. Rings, ideals and quotient rings, polynomial rings. Fields, extension fields, elements of Galois theory.

MA 523 TOPICS IN APPLIED MATHEMATICS 3 (3-0) F

Corequisites: MA 515, MA 520

Formulation of scientific problems in mathematical terms, interpretation and evaluation of the mathematical analysis of the resulting models. The course will discuss problems in behavioral and biological sciences as well as problems in mechanics of discrete and continuous systems. Some discussion of optimization and the calculus of variations.

MA 524 MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES I 3 (3-0) F

Prerequisites: MA 405, MA 512

Green's functions and two point boundary value problems; elementary theory of distributions; generalized Green's functions. Finite and infinite dimensional inner product spaces; Hilbert spaces; completely continuous operators; integral equations, the Fredholm alternative; eigenfunction expansions; applications to potential theory. Nonsingular and singular Sturm-Liouville problems; Weil's theorem.

MA 525 MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES II 3 (3-0) S

Prerequisite: MA 524

Distribution theory in  $n$ -space; Fourier transforms; partial differential equations, generalized solutions, fundamental solutions, Cauchy problem, wave and heat equations, well-set problems, Laplace's equation, the Dirichlet and Neumann problems, integral equations of potential theory, Green's functions, eigenfunction expansions.

MA 527 (CSC 527) NUMERICAL ANALYSIS I 3 (3-0) F S

Prerequisites: CSC 101 or CSC 111, MA 301 or MA 312 and MA 231 or MA 405

Theory of interpolation, numerical integration, iterative solution of nonlinear equations, numerical integration of ordinary differential equations, matrix inversion and solution of simultaneous linear equations.

MA 528 (CSC 528) NUMERICAL ANALYSIS II 3 (3-0) F S

Prerequisite: MA 527

Least squares data approximation, expansions in terms of orthogonal functions, Gaussian quadrature, economization of series, minimax approximations, Pade approximations, eigenvalues of matrices.

- MA 532 THEORY OF ORDINARY DIFFERENTIAL EQUATIONS 3 (3-0) S  
Prerequisites: MA 301 or MA 312, MA 405, advanced calculus  
Existence and uniqueness theorems, systems of linear equations, fundamental matrices, matrix exponential, series solutions, regular singular points; plane autonomous systems, stability theory.
- MA 536 LOGIC FOR DIGITAL COMPUTERS 3 (3-0) F  
Prerequisite: MA 405  
Introduction to symbolic logic and Boolean algebra, finite state-valued calculus and its application to combinational networks; sequential finite-state machines and their mathematical formulation; analysis and synthesis problems of sequential machines.
- MA 537 MATHEMATICAL THEORY OF DIGITAL COMPUTERS 3 (3-0) S  
The sequential machine and its characteristic semi-group; micro-programmed computers; general purpose computers and special purpose computers; Turning machine and infinite-state machines; nondeterministic switching system and probabilistic automata.
- MA 541 (ST 541) THEORY OF PROBABILITY I 3 (3-0) F  
Prerequisite: MA 425 or MA 511  
Axioms, combinatorial analysis, conditional probability, independence, random variables, expectation, special discrete and continuous distributions, probability and moment generating functions, central limit theorem, laws of large numbers, branching processes, recurrent events, random walk.
- MA 542 (ST 542) THEORY OF PROBABILITY II 3 (3-0) S  
Prerequisites: MA 405, MA 541  
Markov chains and Markov processes, Poisson process, birth and death processes, queueing theory, renewal theory, stationary processes, Brownian motion.
- MA 545 SET THEORY AND FOUNDATIONS OF MATHEMATICS 3 (3-0) S  
Prerequisite: MA 403  
Logic and the axiomatic approach, the Zermelo-Fraenkel axioms and other systems, algebra of sets and order relations, equivalents of the Axiom of Choice, one-to-one correspondences, cardinal and ordinal numbers, The Continuum Hypothesis.
- MA 555 (PY 555) MATHEMATICAL INTRODUCTION TO  
CELESTIAL MECHANICS 3 (3-0) F  
Prerequisite: One year of advanced calculus  
Central orbits, N-body problems, 3-body problems, Hamilton-Jacobi theory, Perturbation theory, applications to motion of celestial bodies.
- MA 556 (PY 556) ORBITAL MECHANICS 3 (3-3) S  
Prerequisites: MA 301, MA 405, knowledge of elementary mechanics and computer programming  
Keplerian motion, iterative solutions, numerical integration, differential corrections and space navigation, elements of probability, least squares, sequential estimation, Kalman fields.
- MA 571 (BMA 571, ST 571) BIOMATHEMATICS I 3 (3-0) F  
(See biomathematics, page 263.)
- MA 572 (BMA 572, ST 572) BIOMATHEMATICS II 3 (3-0) S  
(See biomathematics, page 263.)

MA 581	SPECIAL TOPICS	1-6 F S
Prerequisite: Consent of department		

## FOR GRADUATES ONLY

MA 600	ADVANCED DIFFERENTIAL EQUATIONS I	3 (3-0) F
MA 601	ADVANCED DIFFERENTIAL EQUATIONS II	3 (3-0) S
MA 602	PARTIAL DIFFERENTIAL EQUATIONS I	3 (3-0) S
MA 603	PARTIAL DIFFERENTIAL EQUATIONS II	3 (3-0) F
MA 604	TOPOLOGY	3 (3-0) S
MA 605	HOMOLOGY AND MANIFOLDS	3 (3-0) F
MA 606	(ST 606, OR 606) MATHEMATICAL PROGRAMMING II	3 (3-0) S
MA 611	ANALYTIC FUNCTION THEORY I	3 (3-0) F
MA 612	ANALYTIC FUNCTION THEORY II	3 (3-0) S
MA 613	TECHNIQUES OF COMPLEX ANALYSIS	3 (3-0) S
MA 615	THEORY OF FUNCTIONS OF A REAL VARIABLE	3 (3-0) F
MA 617	(ST 617) MEASURE THEORY AND ADVANCED PROBABILITY	3 (3-0) F
MA 618	(ST 618) MEASURE THEORY AND ADVANCED PROBABILITY	3 (3-0) S
MA 619	(ST 619) TOPICS IN ADVANCED PROBABILITY	3 (3-0) Sum.
MA 620	MODERN ALGEBRA I	3 (3-0) F
MA 621	MODERN ALGEBRA II	3 (3-0) S
MA 622	LINEAR TRANSFORMATIONS AND MATRIX THEORY	3 (3-0) F
MA 623	THEORY OF MATRICES AND APPLICATIONS	3 (3-0) S
MA 626	ALGEBRAIC TOPOLOGY	3 (3-0) S
MA 628	GENERAL TOPOLOGY	3 (3-0) F
MA 632	OPERATIONAL MATHEMATICS I	3 (3-0) F
MA 633	OPERATIONAL MATHEMATICS II	3 (3-0) S
MA 634	THEORY OF DISTRIBUTIONS	3 (3-0) F
MA 635	NUMERICAL ANALYSIS III	3 (3-0) S
MA 637	DIFFERENTIABLE MANIFOLDS	3 (3-0) F
MA 641	CALCULUS OF VARIATIONS AND THEORY OF OPTIMAL CONTROL I	3 (3-0) F
MA 642	CALCULUS OF VARIATIONS AND THEORY OF OPTIMAL CONTROL II	3 (3-0) S

MA 647	FUNCTIONAL ANALYSIS I	3 (3-0) F
MA 648	FUNCTIONAL ANALYSIS II	3 (3-0) S
MA 655	(PY 655) QUALITATIVE METHODS IN CELESTIAL MECHANICS	3 (3-0) F
MA 656	(PY 656) PERTURBATION THEORY IN CELESTIAL MECHANICS	3 (3-0) S
MA 661	DIFFERENTIAL GEOMETRY AND TENSOR ANALYSIS I	3 (3-0) F
MA 662	DIFFERENTIAL GEOMETRY AND TENSOR ANALYSIS II	3 (3-0) S
MA 681	SPECIAL TOPICS IN REAL ANALYSIS	1-6
MA 682	SPECIAL TOPICS IN COMPLEX ANALYSIS	1-6
MA 683	SPECIAL TOPICS IN ALGEBRA	1-6
MA 684	SPECIAL TOPICS IN COMBINATORIAL ANALYSIS	1-6
MA 685	SPECIAL TOPICS IN NUMERICAL ANALYSIS	1-6
MA 686	SPECIAL TOPICS IN TOPOLOGY	1-6
MA 687	SPECIAL TOPICS IN GEOMETRY	1-6
MA 688	SPECIAL TOPICS IN DIFFERENTIAL EQUATIONS	1-6
MA 689	SPECIAL TOPICS IN APPLIED MATHEMATICS	1-6
MA 692	(IE 692, OR 692) SPECIAL TOPICS IN MATHEMATICAL PROGRAMMING	3 (3-0) F S Sum.
MA 699	RESEARCH	Credits Arranged

## MATHEMATICS AND SCIENCE EDUCATION

### FOR UNDERGRADUATES

ED 101 ORIENTATION 0 (1-0) F

New freshmen and transfer students are required to attend one hour per week during the fall semester. Activities center around helping the student to establish good study habits and to adjust to university life.  
Staff

ED 203 INTRODUCTION TO TEACHING MATHEMATICS AND SCIENCE 3 (2-3) F S

A beginning course designed for prospective teachers of mathematics/science at a secondary school level. Emphasis is given to study of different modes of instruction and instructional strategies. Each prospective teacher is expected to design a lesson and teach it to students in the school to which he is assigned as a teacher assistant. (Offered in spring only for science education majors.)  
Staff

ED 470 METHODS OF TEACHING MATHEMATICS 3 (3-0) F S

Prerequisite: Admission to teacher education

A study of the purposes, methods, materials, curricula and evaluation practices appropriate for teachers of mathematics at the secondary level.

Messrs. Kolb, Speece, Waters, Watson

**ED 471 STUDENT TEACHING IN MATHEMATICS****8 (2-15) F S**

Prerequisites: ED 344, PSY 304, senior standing, admission to teacher education and overall 2.0 average

This course is intended to provide the prospective teacher with an opportunity to get experience in the skills and the techniques involved in teaching mathematics. Each student during the senior year will spend 10 weeks off campus in a selected center. In addition to acquiring the necessary competencies for teaching mathematics, the student teachers also will have an opportunity to become familiar with the total school program and to participate in as many community activities as time will permit during the period of student teaching.

Messrs. Kolb, Speece, Waters, Watson

**ED 472 DEVELOPING AND SELECTING TEACHING MATERIALS  
IN MATHEMATICS****2(2-0) F S**

Developing and selecting teaching materials in keeping with the new and changing concepts of the content and emphasis in high school mathematics is essential for mathematics teachers. The course will follow the class discussion and demonstration pattern. Students will study the latest instructional materials and discover or devise materials and aids for increasing the effectiveness of the content and instruction in high school mathematics.

Messrs. Kolb, Speece, Waters, Watson

**ED 475 METHODS OF TEACHING SCIENCE****3 (3-0) F**

A study of the purposes, methods, materials, curricula and evaluation practices appropriate for teachers of physical and natural science at the secondary level.

Messrs. Anderson, Shannon

**ED 476 STUDENT TEACHING IN SCIENCE****8 (2-15) F**

Prerequisites: ED 344, PSY 304, senior standing, admission to teacher education and an overall 2.0 average

This course is intended to provide prospective teachers with an opportunity to get experience in the skills and techniques involved in teaching science. Each student during the senior year will spend 10 weeks off campus in a selected center. In addition to acquiring the necessary competencies for teaching science, the student teacher also will have an opportunity to become familiar with the total program and to participate in as many community activities as time will permit during the period of student teaching.

Messrs. Anderson, Shannon

**ED 477 DEVELOPING AND SELECTING TEACHING MATERIALS  
IN SCIENCE****2(2-0) F**

Developing and selecting teaching materials in keeping with the new and changing concepts of the content and emphasis in high school science, particularly the experimental and laboratory approach to science teaching. Students will study the latest instructional materials and discover or devise materials and aids for increasing the effectiveness of the content and instruction in high school science courses.

Messrs. Anderson, Shannon

**ED 495 SENIOR SEMINAR IN MATHEMATICS AND  
SCIENCE EDUCATION****3 (3-0) F S**

An in-depth investigation of a teaching area in mathematics and/or science education by above-average department majors following their student teaching.

Staff

**FOR GRADUATES AND ADVANCED UNDERGRADUATES****ED 511 IMPLICATIONS OF MATHEMATICAL CONTENT, STRUCTURE  
AND PROCESSES FOR THE TEACHING OF  
MATHEMATICS IN THE ELEMENTARY SCHOOL****3 (3-0) F S**

Prerequisite: Bachelor's degree in elementary education, or permission of instructor

A course designed for teachers and supervisors of mathematics in the elementary school. Special emphasis is given to the implications of mathematical content, structure, and processes in teaching arithmetic and geometry in the elementary school. Attention is given to the use of logic and fundamental rules of inference, deductive and inductive reasoning, the field properties in the sets of integers and rational numbers, elementary number theory, metric and non-metric geometry.

Mr. Watson

**ED 512 ACTIVE LEARNING APPROACHES TO TEACHING MATHEMATICS  
IN THE ELEMENTARY SCHOOL**

3 (3-0) F S

Prerequisite: Bachelor's degree in elementary education or permission of instructor

A course that will stress active learning approaches to the teaching of mathematics in the elementary school. Special emphasis will be given to the laboratory approach to teaching mathematics and the use of the manipulative materials and activities of the Nuffield Project, the Madison Project, Dienes, Cuisenaire, and Gattegno. Attention will be given to research supporting the laboratory approach using manipulative materials in the elementary school. Suggestions will be given for designing activities for independent and group study and in assessing individual progress.

Mr. Watson

**ED 592 SPECIAL PROBLEMS IN MATHEMATICS TEACHING**

3 (3-0) F S

Prerequisite: ED 471 or equivalent

An investigation of current problems in mathematics teaching, with emphasis on the areas of curriculum, methodology, facilities, supervision and research. Specific problems will be studied in depth. Opportunities will be provided to initiate research studies.

**ED 594 SPECIAL PROBLEMS IN SCIENCE TEACHING**

3 (0-3) F S

Prerequisite: ED 476 or equivalent

An investigation of current problems in science teaching with emphasis on areas of curriculum, methodology, facilities, supervision and research. Specific problems will be studied in depth. Opportunities will be provided to initiate research studies.

**FOR GRADUATES ONLY**

**ED 603 TEACHING MATHEMATICS AND SCIENCE IN HIGHER EDUCATION**

3 (3-0) F

**ED 604 CURRICULUM DEVELOPMENT AND EVALUATION IN  
SCIENCE AND MATHEMATICS**

3 (3-0) F S

**ED 605 EDUCATION AND SUPERVISION OF TEACHERS OF  
MATHEMATICS AND SCIENCE**

3 (3-0) S

**ED 690 SEMINAR IN MATHEMATICS EDUCATION**

Maximum 2 F S

**ED 695 SEMINAR IN SCIENCE EDUCATION**

Maximum 2 F S

**ED 699 RESEARCH**

Credits Arranged

**MECHANICAL AND AEROSPACE ENGINEERING**

**MAE 200 MECHANICAL TECHNOLOGY IN CONTEMPORARY SOCIETY**

3 (3-0) F S

Prerequisite: Sophomore standing

A presentation of the role mechanical and aerospace engineering plays in our present technological society with the approaches used by these engineers in solving

problems. Topics covered will include the areas of power generation, modern flight, and transportation vehicles.

**MAE 216 ELEMENTS OF MECHANICAL ENGINEERING** 3 (3-0) S  
Prerequisites: EM 205, PY 208 or PY 202

An introductory consideration of the scope and interests in mechanical engineering through the application and extension of chemistry, physics and mathematics to real engineering problems in analysis and design.

**MAE 250 INTRODUCTION TO AEROSPACE ENGINEERING** 3 (3-0) S  
Prerequisite: PY 205

Fundamental concepts underlying aerospace engineering. A basic study of the aerodynamics, structural, propulsion, performance and control requirements of flight vehicles.

**MAE 301 ENGINEERING THERMODYNAMICS I** 3 (3-0) F S  
Prerequisites: MA 202, PY 208 or PY 202

An introduction to the concept of energy and the laws governing the transfers and transformations of energy. Emphasis is placed on thermodynamic properties and First and Second law analysis of systems. Some basic statistical thermodynamic concepts are introduced and applied to the calculation of properties.

**MAE 302 ENGINEERING THERMODYNAMICS II** 3 (3-0) S  
Prerequisite: MAE 301

A continuation of Engineering Thermodynamics I with emphasis on the application of basic principles to engineering problems with systems involving mixtures of ideal gases, psychrometrics, nonideal gases, chemical reactions, combustion, chemical equilibrium, cycle analysis and one-dimensional compressible flow.

**MAE 303 ENGINEERING THERMODYNAMICS III** 3 (3-0) S  
Prerequisite: MAE 301

A continuation of Engineering Thermodynamics I for nonmechanical engineering juniors. Thermodynamics of mixtures; thermodynamics of fluid flow, heat transfer, vapor and gas cycles, and applications.

**MAE 305 MECHANICAL ENGINEERING LABORATORY I** 1 (0-3) F  
Corequisite: MAE 301

An introduction to the theory and practice of measurement and experimental data collection. The components of the generalized measurement system are studied and their effects on the final result evaluated. Basic methods of data analysis as well as basic instrumentation for sensing, conditioning and displaying experimental quantities are covered.

**MAE 306 MECHANICAL ENGINEERING LABORATORY II** 1 (0-3) S  
Prerequisites: MAE 305, EE 331

A continuation of MAE 305 into specific types of measurements. Students will evaluate and compare different types of instrumentation for measuring the same physical quantity on the basis of cost, time required, accuracy, etc.

**MAE 307 ENERGY AND ENERGY TRANSFORMATIONS** 3 (3-0) F  
Prerequisites: MA 201, PY 212

Energy transformation as permitted by the First Law and limited by the Second Law. Properties of ideal gases and actual gases; properties of vapors. Vapor power cycles; vapor refrigerating cycles, gas cycles for internal combustion engines and gas turbines. Elements of heat transfer.

**MAE 315 DYNAMICS OF MACHINES****3 (3-0) F****Prerequisites:** MAE 216, EM 305

A rational application of dynamics to the analysis of machines and mechanical devices to determine the motions resulting from applied loads and the forces and inputs required to produce specified motions.

**MAE 316 STRENGTH OF MECHANICAL COMPONENTS****3 (3-0) S****Prerequisites:** EM 205, MAT 201

Stress, strain and deformation analysis of mechanical components and their strength determination based on material behavior under static and dynamic operating conditions. Applications to basic machine components.

**MAE 355 AERODYNAMICS I****4 (3-3) F****Prerequisites:** MAE 250, MA 301

Introductory concepts of perfect fluid theory and incompressible boundary layers with application to the computation of the aerodynamic characteristics of airfoils, wings and flight vehicle configurations.

**MAE 356 AERODYNAMICS II****4 (3-3) S****Prerequisites:** MAE 355, MAE 301

Introductory concepts of thermodynamics, compressible fluid flow and compressible boundary layers with application to the computation of the aerodynamic characteristics of airfoils, wings and flight vehicle configurations at high speed.

**MAE 361 AEROSPACE VEHICLE PERFORMANCE****3 (3-0) F****Prerequisites:** MAE 250, MA 301, EM 305

An application of the principles of dynamics and aerodynamics to the problem of determining the performance of both airplanes and space vehicles. Includes the elements of orbital mechanics and dynamics of boost into and reentry from orbit. For aircraft, methods are presented for the calculation of airplane performance in level, gliding and climbing flight as well as take-off and landing performance.

**MAE 365 AIR-BREATHING PROPULSION SYSTEMS****4 (3-3) S****Prerequisites:** MAE 355, MAE 301

Introduction to one-dimensional internal flow of compressible fluids and to combustion and thermochemistry problems. Application of these processes to air-breathing aircraft propulsion systems. Performance analysis of components and complete propulsion systems.

**MAE 371 AEROSPACE VEHICLE STRUCTURES I****3 (3-0) S****Prerequisites:** MAE 250, EM 205

Introduction to the theory and concepts required for the analysis and design of flight vehicle structural members. Properties and selection of materials; methods of analysis for axial, torsional, flexural and transverse shear loadings of typical flight structure members.

**FOR ADVANCED UNDERGRADUATES****MAE 401 ENERGY CONVERSION****3 (3-0) F S****Prerequisite:** MAE 302

Applications of the principles of thermodynamics, fluid mechanics, heat transfer and combustion to power generation. Both the conventional and direct energy conversion methods are studied as to the principles involved and the feasibility and limitations of each method. Consideration is given to the economics of power generation.

**MAE 402 HEAT AND MASS TRANSFER** 3 (3-0) F S  
Prerequisites: MAE 302, MA 301

A study of the fundamental relationships of steady and transient heat transfer by conduction, convection, radiation and during changes of phase: mass transfer by diffusion and convection, simultaneous mass and heat transfer.

**MAE 403 AIR CONDITIONING** 3 (3-0) F  
Prerequisite: MAE 302

A fundamental study of summer and winter air conditioning including temperature, humidity, air velocity and distribution.

**MAE 404 REFRIGERATION** 3 (3-0) S  
Prerequisite: MAE 302

A thermodynamic analysis of the simple, compound, centrifugal and multiple effect compression systems, the steam jet system and the absorption system of refrigeration.

**MAE 405 MECHANICAL ENGINEERING LABORATORY III** 1 (0-3) F  
Prerequisite: MAE 306

The final course in the undergraduate mechanical laboratory sequence which exposes the student to case studies in experimental engineering, and provides him the opportunity to select instrumentation and design a complete experimental set up for a specific problem.

**MAE 409 PARTICULATE CONTROL IN INDUSTRIAL ATMOSPHERIC POLLUTION** 3 (3-0) F  
Prerequisite: MAE 301 or equivalent

Combustion calculations and analysis of particulate emission and gases from industrial and utility power stations burning various types of fuel. State and Federal Pollution codes, requirements for compliance and enforcement. Calculations and design of industrial equipment to combat pollution. Utilization of waste products from industrial plants.

**MAE 411 MECHANICAL DESIGN I** 3 (3-0) F or S  
Prerequisites: MAE 315, MAE 316

Application of the engineering and materials sciences to the analysis and design of mechanical components including screws and fasteners, antifricition and journal bearings, springs, gears, shafts, clutches, breaks and couplings, etc.

**MAE 415 MECHANICAL ENGINEERING ANALYSIS** 3 (3-0) F  
Prerequisites: MAE 302, MAE 315, MAE 316, EE 331

Consideration of a logical method of problem solving through the integration of the physical sciences, engineering sciences and mathematics and their use in a rigorous training in methods of analysis of real mechanical engineering problems.

**MAE 416 MECHANICAL ENGINEERING DESIGN** 4 (3-2) S  
Prerequisite: MAE 415

Application of the engineering and materials sciences to the total design of mechanical engineering components and systems. Consideration and utilization of the design process including problem definition, solution synthesis, design analysis, optimization and prototype evaluation through design project activity.

**MAE 422 DIRECT ENERGY CONVERSION** 3 (3-0) S  
Prerequisites: MAE 301, EE 202 or EE 332

Theory and application of direct energy conversion methods, including magnetohydrodynamic and electrogasdynamic generators, fuel cells, and other methods of

current interest. Thermodynamic analyses, device characteristics, and design considerations are emphasized.

**MAE 431 THERMODYNAMICS OF FLUID FLOW** 3 (3-0) F  
Prerequisites: MA 301, MAE 302, EM 303 or MAE 355

The fundamental dynamics and thermodynamic principles governing the flow of gases are presented from both theoretical and experimental viewpoints. Mathematical relations are closely correlated with physical phenomena to emphasize the complementary nature of theory and experiment.

**MAE 435 PRINCIPLES OF AUTOMATIC CONTROL** 3 (3-0) F S  
Prerequisite: MA 301

Study of linear feedback control systems using transfer functions. Transient and steady-state responses. Stability analysis using rootlocus and frequency response techniques (Bode plots and Nyquist diagrams). Active and passive compensation methods. Preliminary design and analysis of typical mechanical and aerospace automatic control systems.

**MAE 462 FLIGHT VEHICLE STABILITY AND CONTROL** 3 (3-0) F  
Prerequisite: MAE 361

Linearized dynamic analysis of the motion of a six degree-of-freedom flight vehicle in response to control inputs and disturbance through use of the transfer function concept. Control of dynamic behavior by vehicle design (stability derivatives) and/or flight control systems.

**MAE 467 ROCKET PROPULSION** 3 (3-0) F  
Prerequisite: MAE 365

Performance analysis and design of liquid fuel, solid fuel, nuclear and electrical rocket propulsion systems.

**MAE 471 (MAS 471) UNDERSEA VEHICLE DESIGN** 3 (3-0) F or S  
Prerequisite: MAE 355 or EM 303

An introduction to the solution of problems encountered in the design of both submerged and semisubmerged ocean vehicles. Included are discussions and analytical treatments of vehicle drag and lift, buoyancy effects, vehicle propulsion and systems integration.

**MAE 472 AEROSPACE VEHICLE STRUCTURES II** 4 (3-3) F  
Prerequisite: MAE 371

A continuation of MAE 371 with emphasis on specialized topics such as semi-monocoque structures, deflection of structures, indeterminate structures, torsion analysis. A laboratory is included to demonstrate the theory and application of resistance strain gages, and to provide an opportunity for actual load-stress-deflection tests on typical flight vehicle structure components, as well as the determination of basic materials properties, and correlation of tests and analytical results.

**MAE 474 MATRIX STRESS AND DEFORMATION ANALYSIS** 3 (3-0) S  
Prerequisites: MAE 316 or MAE 371 or EM 307 or EM 301

Development of the fundamentals and application of matrix methods of stress and deformation analysis for load-carrying components typical of aerospace and mechanical engineering systems.

**MAE 479 AEROSPACE VEHICLE DESIGN** 4 (2-6) S  
Prerequisites: MAE 356, MAE 462, MAE 467, MAE 472, EE 332

A synthesis of all previously acquired theoretical and empirical knowledge and application to the design of practical aerospace vehicle systems.

**MAE 495 TECHNICAL SEMINAR IN MECHANICAL AND AEROSPACE ENGINEERING** 1 (1-0) F S  
Prerequisite: Senior standing  
Meetings once a week for the delivery and discussion of student papers on topics of current interest in mechanical engineering.

**FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**MAE 501 STEAM AND GAS TURBINES** 3 (3-0) F or S  
Prerequisites: MAE 302, EM 303 or MAE 355  
Fundamental analysis of the theory and design of turbomachinery flow passages; control and performance of turbomachinery; gas-turbine engine processes.

**MAE 507, 508 INTERNAL COMBUSTION ENGINE FUNDAMENTALS** 3 (3-0) F S  
Prerequisite: MAE 302  
The fundamentals common to internal combustion engine cycles of operation. The Otto engine; carburetion, fuel distribution, flame and spark timing, and altitude effects; the Diesel engine; injection knock, combustion, precombustion and scavenging as applied to reciprocating and rotary engines.

**MAE 510 THEORY OF PARTICULATE COLLECTION IN AIR POLLUTION CONTROL** 3 (3-0) S  
Prerequisite: MAE 409 or graduate standing  
Particulate matter is classified and its properties are described. The motion of particles as applied to particulate collection is carefully analyzed. The elements of aerodynamic capture of particles are developed and applications in filtration and liquid scrubbing are considered. Fundamentals of acoustical, electrostatic and thermal precipitation are introduced. Sampling techniques and instrumentation are also considered.

**MAE 513 VIBRATION AND NOISE CONTROL** 3 (2-3) F  
Prerequisite: MAE 315 or MAE 472  
This course will be devoted to a study of the nature and origin of vibration and noise in mechanical systems and design for their control. Considerations will include source reduction, isolation, transmission, damping and acoustic shielding techniques, through classroom discussions and laboratory demonstrations.

**MAE 515 EXPERIMENTAL STRESS ANALYSIS** 3 (2-3) F  
Prerequisite: MAE 316  
Theoretical and experimental techniques of strain and stress analysis with emphasis on electrical strain gages and instrumentation, brittle coatings, grid methods and an introduction to photoelasticity. Laboratory includes an investigation and complete report of a problem chosen by the student under the guidance of the instructor.

**MAE 516 PHOTOELASTICITY** 3 (2-3) S  
Prerequisite: MAE 316  
Theory and experimental techniques of two- and three-dimensional photoelasticity including photoelastic coatings, photoplasticity and an application of photoelastic methods to the solution of mechanical design problems. Laboratory includes an investigation and complete report of a problem chosen by the student under the guidance of the instructor.

**MAE 517 LUBRICATION** 3 (2-3) S  
Prerequisite: EM 303  
The theory of hydrodynamic lubrication; Reynold's equation, the Sommerfeld integration, effect of variable lubricant properties and energy equation for tem-

perature rise. Properties of lubricants. Application to design of bearings. Boundary lubricants. Solid film lubrication.

**MAE 518 ACOUSTIC RADIATION I**

3 (3-0) F or S

Prerequisite: MA 301

Discussion of the principles of acoustic radiation as related to acoustic sources and their related fields. The radiation of single sources (point, plane, line cylinder, spheres, etc.) and combinations thereof are considered.

**MAE 521 AEROTHERMODYNAMICS**

3 (3-0) F or S

Prerequisites: MAE 301, MAE 355 or EM 303

Review of basic thermodynamics pertinent to gas dynamics. Detailed development of the general equations governing gas motion in both differential and integral form. Simplification of the equations to those for specialized flow regimes. Similarity parameters. Applications to simple problems in various flow regimes.

**MAE 531 PLASMAGASDYNAMICS I**

3 (3-0) F or S

Prerequisites: MAE 356, PY 414

Study of basic laws governing plasma motion for dense and rarefied plasmas, hydro-magnetic shocks, plasma waves and instabilities, simple engineering applications.

**MAE 532 PLASMAGASDYNAMICS II**

3 (3-0) F or S

Prerequisite: MAE 531

Quantum statistics and ionization phenomena. Charged particles interactions. Transport properties in the presence of electric and magnetic fields and nonequilibrium ionization.

**MAE 535 (EE 535) GAS LASERS**

3 (3-0) F or S

Prerequisites: MAE 356 or equivalent, PY 407

Study of the principles, design and potential applications of ion, molecular, chemical and atomic gas lasers.

**MAE 541, 542 AERODYNAMIC HEATING**

3 (3-0) F S

Prerequisites: MA 511, MAE 521

A detailed study of the latest theoretical and experimental findings of the compressible laminar and turbulent boundary layers with special attention to the aerodynamic heating problem. Application of theory in the analysis and design of aerospace hardware.

**MAE 543 HEAT TRANSFER—THEORY AND APPLICATIONS**

3 (3-0) F or S

Prerequisite: MAE 402 or equivalent

Development of basic equations for steady and transient heat and mass transfer processes. Emphasis is placed on the applications of the basic equations to engineering problems in the areas of conduction, convection, mass transfer and thermal radiation.

**MAE 545, 546 PROJECT WORK IN MECHANICAL ENGINEERING I, II**

2 (0-4) F S

Individual or small group investigation of a problem stemming from a mutual student-faculty interest. Emphasis is placed on providing a situation for exploiting student curiosity.

**MAE 550 CRYOGENICS I**

3 (3-0) F or S

Prerequisite: MAE 402

A study of the thermodynamic processes required to produce cryogenic fluids. Properties of materials at cryogenic temperatures. Insulation of cryogenic vessels and lines. Design of cryogenic systems.



MAE 614	MECHANICAL TRANSIENTS AND MACHINE VIBRATIONS	3 (3-0) S
MAE 615	AEROELASTICITY I	3 (3-0) F
MAE 617	MECHANICAL SYSTEM DESIGN ANALYSIS	3 (3-0) F
MAE 618	MECHANICAL SYSTEM DESIGN SYNTHESIS	3 (3-0) S
MAE 619	RANDOM VIBRATION	3 (3-0) F or S
MAE 622	ACOUSTIC RADIATION II	3 (3-0) F or S
MAE 625, 626	DIRECT ENERGY CONVERSION	3 (3-0) F S
MAE 631	APPLICATIONS OF ULTRASONICS TO ENGINEERING RESEARCH	3 (3-0) F
MAE 651	PRINCIPLES OF FLUID MOTION	3 (3-0) F
MAE 652	DYNAMICS OF COMPRESSIBLE FLOW	3 (3-0) F
MAE 653	SUPERSONIC AERODYNAMICS	3 (3-0) S
MAE 654	DYNAMICS OF VISCOUS FLUIDS I	3 (3-0) F
MAE 655	DYNAMICS OF VISCOUS FLUIDS II	3 (3-0) S
MAE 657	MEASUREMENT IN RAREFIED GAS STREAMS	3 (3-0) F
MAE 658, 659	MOLECULAR GAS DYNAMICS	3 (3-0) F S
MAE 661, 662	AEROSPACE ENERGY SYSTEMS	3 (3-0) F S
MAE 663 (TX 663)	MECHANICS OF TWISTED STRUCTURES	3 (3-0) F
MAE 664 (TX 664)	MECHANICS OF FABRIC STRUCTURES	3 (3-0) S
MAE 671, 672	ADVANCED AIR CONDITIONING DESIGN I, II	3 (3-0) F S
MAE 674, 675	ADVANCED SPACECRAFT DESIGN	3 (3-0) F S
MAE 681	INTRODUCTION TO ROCKET PROPULSION	3 (3-0) F
MAE 682	SOLID PROPELLANT ROCKETS	3 (3-0) S
MAE 683	LIQUID PROPELLANT ROCKETS	3 (3-0) S
MAE 684	ION PROPULSION	3 (3-0) F or S
MAE 693	ADVANCED TOPICS IN MECHANICAL ENGINEERING	1-6 F or S
MAE 695	MECHANICAL ENGINEERING SEMINAR	1 (1-0) F or S
MAE 699	MECHANICAL ENGINEERING RESEARCH	Credits Arranged

# METEOROLOGY

## FOR UNDERGRADUATES

**MY 201 ATMOSPHERIC ENVIRONMENT** 3 (3-0) F S  
Prerequisite: High school physics, chemistry, algebra, trigonometry, or equivalent

A survey course on man's atmospheric environment designed to meet general needs in modern college education. Subjects include the nature and processes of the atmosphere, the interactions with land, sea, and life at the surface, the relations to other components of the solar system; measurements and surveillance of the atmosphere and relations to climatology, weather forecasting, weather modification and air pollution, and applications to various human activities.

**MY 411 INTRODUCTORY METEOROLOGY** 3 (3-0) F  
Prerequisites: PY 208 or PY 212; MA 201 or MA 212

The physical setting: coordinates, planetary motion, gravitation; composition and structure of the atmosphere; insolation and diurnal phenomena; heat balance of the atmosphere; consequent distribution of variables of state, motion and weather.

**MY 412 ATMOSPHERIC PHYSICS** 3 (3-0) S  
Prerequisite: MY 411 or consent of instructor

Atmospheric effects on electromagnetic and acoustic transmission, and the consequent phenomena; terrestrial radiation; radar meteorology, visibility; atmospheric electricity and magnetism.

**MY 421 ATMOSPHERIC STATICS AND THERMODYNAMICS** 3 (3-0) F  
Prerequisites: PY 208 or PY 212; MA 202

The variables of state and thermodynamics of dry and moist air in the atmospheric system; water phase changes; hydrostatics and altimetry; stability, convection and diffusion; transfers at the surface; natural modification of air.

**MY 422 ATMOSPHERIC KINEMATICS AND DYNAMICS** 3 (3-0) S  
Prerequisites: PY 207 or PY 208; MA 202  
Corequisite: MY 421 or consent of instructor

Properties and fields of atmospheric motion, and variations with time; forces and force fields; equilibrium and accelerated motions; the boundary layer and momentum transfer; continuity, pressure tendency and divergence-vorticity theorems.

**MY 435 MEASUREMENTS AND DATA SYSTEMS** 3 (2-3) S  
Prerequisite: MY 421

Meteorological instruments, observations and networks; data communications, reduction and presentation; meteorological charts and diagrams, fundamental analysis of physical distributions.

**MY 441 METEOROLOGICAL ANALYSIS I** 3 (3-0) F  
Prerequisites: MY 422, MY 435

Theory and analysis of atmospheric distributions, processes and developments in the three space dimensions and time.

**MY 443 METEOROLOGICAL LABORATORY I** 4 (0-10) F  
Prerequisite: MY 435  
Corequisite: MY 441

Laboratory course in analysis of atmospheric distributions, processes and developments, employing regularly available meteorological data and the principles presented in prerequisite and corequisite courses. The purpose is to gain working

knowledge of integrated atmospheric systems and processes through detailed analyses of natural situations.

**MY 444 METEOROLOGICAL LABORATORY II** 4 (0-10) S  
Prerequisite: MY 443

Laboratory course in analysis and application of principles and concepts for predicting developments in the weather.

**MY 486 WEATHER AND CLIMATE** 2 (2-0) F  
Prerequisites: MY 102 or MA 112, PY 211, 212 or PY 221

A discussion of basic principles of meteorology and climatology. Topics discussed include the atmosphere, radiation, moisture, pressure and wind, atmospheric equilibrium, air masses and fronts. Macro- and microclimate and the climate of North Carolina are also covered.

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

**MY 512 MICROMETEOROLOGY** 3 (3-0) F  
Prerequisite: MY 422

Meteorology of the lowest hundred meters of the atmosphere with emphasis on the transport of momentum, heat, water vapor, and effluents and their transfer through the earth's surface.

**MY 521 THE UPPER ATMOSPHERE** 3 (3-0) S  
Prerequisite: MY 411 or consent of instructor

Meteorological conditions in the upper atmosphere from the stratosphere to the ionosphere. Compositions, mean distributions and variabilities, and circulation and transport properties in the region. Physical theories.

**MY 555 METEOROLOGY OF THE BIOSPHERE** 3 (3-0) F  
Prerequisites: PY 205 or PY 211; CH 103 or CH 107; MA 102 or MA 112

A course designed for graduate students in the life sciences, presenting the physical principles governing the states and processes of the atmosphere in contact with earth's surface of land, water, and life. Exchanges of heat, mass, and momentum are analyzed for various conditions of the atmosphere and surface, and as a function of season, time, and geographic location.

**MY 556 AIR POLLUTION METEOROLOGY** 3 (3-0) S  
Prerequisite: MY 555 or equivalent

The meteorological aspects of air pollution, especially for nonmeteorologists engaged in graduate training for work involving air pollution.

**MY 593 ADVANCED TOPICS** 1-6 F S  
Prerequisite: Consent of staff

Special topics of advanced nature in the field of meteorology, provided to groups or assigned to individual students.

## FOR GRADUATES ONLY

**MY 612 ATMOSPHERIC RADIATIVE TRANSFER** 3 (3-0) S

**MY 627 ATMOSPHERIC TURBULENCE AND DIFFUSION** 3 (3-0) F

**MY 635 DYNAMICAL ANALYSIS OF THE ATMOSPHERE** 3 (2-3) F

## MICROBIOLOGY

### FOR UNDERGRADUATES

MB 301 MICROBIAL LIFE 3 (3-0) Sum.

An introduction to the basic concepts of microbiology at an elementary level requiring no college-level prerequisites in chemistry or biology. Although given as a terminal course, it emphasizes modern fundamental knowledge and concepts in sufficient depth that superior students may take MB 302 and organic chemistry and then take MB 501. Students cannot receive credit for both MB 301 and MB 401.

Mr. Hayes

MB 302 CLINICAL MICROBIOLOGY LAB 1 (0-2) Sum.  
Corequisite: MB 301

Techniques of isolating and characterizing microorganisms of medical significance. For student nurses and other paramedical students.

Mr. Hayes

### FOR ADVANCED UNDERGRADUATES

MB 401 GENERAL MICROBIOLOGY 4 (3-3) S  
Prerequisites: BS 100, CH 223 or CH 220

A rigorous introduction to the basic principles and concepts of modern microbiology. This course is recommended for students in the biological sciences and agricultural sciences curricula and for all students who plan to take further courses in microbiology. Credit will not be granted for both MB 301 and MB 401.

Mr. Elkan

MB 405 (FS 405) FOOD MICROBIOLOGY 3 (2-3) F  
(See food science, page 335.)

### FOR GRADUATES AND ADVANCED UNDERGRADUATES

MB 501 ADVANCED MICROBIOLOGY 4 (3-2) F  
Prerequisite: MB 401

An in-depth examination of microorganisms in relation to their natural environments, their taxonomic, nutritional, structural, and physiological interrelationships.

Mr. Perry

MB 506 (FS 506) ADVANCED FOOD MICROBIOLOGY 3 (1-6) S  
(See food science, page 335.)

MB 507 (PP 507) PATHOGENIC MICROBIOLOGY 4 (3-2) F  
Prerequisite: MB 401

A study of pathogenic microorganisms and their interaction with susceptible hosts. Emphasis will be on the principles and processes of infection and immunity as they relate to common diseases of man, plants and animals.

Mr. Hayes

MB 514 MICROBIAL METABOLISM 4 (3-2) S  
Prerequisites: MB 401, BCH 351 or BCH 551

A study of the metabolic processes of microorganisms and their regulatory mechanisms.

Mr. Dobrogosz

- MB 521 MICROBIAL ECOLOGY** 1 (1-0) S  
 Prerequisites: Senior or graduate standing  
 Concepts of microbial ecology as they relate to the role of microorganisms in the biosphere. The interaction of microbes and environmental pollutants is discussed.  
 Mr. Perry
- MB 532 (SSC 532) SOIL MICROBIOLOGY** 3 (3-0) S  
 (See soil science, page 458.)
- MB 551 IMMUNOLOGY AND SEROLOGY** 2 (1-2) S  
 Prerequisite: MB 401  
 Concepts, principles and mechanisms of antibody production, antigen-antibody interaction, and the laboratory techniques for their demonstration and study.  
 Mr. Lecce
- MB 555 (ZO 555) PROTOZOOLOGY** 4 (2-6) F  
 (See zoology, page 483.)
- MB 561 (GN 561, BCH 561) BIOCHEMICAL AND MICROBIAL GENETICS** 3 (3-0) F  
 (See biochemistry, page 257.)
- MB 570 (BAE 570, CE 570) SANITARY MICROBIOLOGY** 3 (2-3) S  
 (See civil engineering, page 282.)
- MB 571 VIROLOGY** 3 (3-0) S  
 Prerequisites: BCH 551, MB 401  
 An introduction to the fundamental aspects of virus-cell interactions. These include virus attachment and penetration, intracellular virus replication, metabolic changes occurring in cells as a result of virus infection and virus-induced cellular transformations.  
 Mr. Hayes
- MB 574 (BO 574) PHYCOLOGY** 3 (1-4) S  
 (See botany, page 266.)
- MB 575 (BO 575, PP 575) THE FUNGI** 3 (3-0) S  
 (See botany, page 266.)
- MB 576 (BO 576, PP 576) THE FUNGI—LAB** 1 (0-3) S  
 (See botany, page 266.)
- MB 590 TOPICAL PROBLEMS** Credits Arranged F S  
 Prerequisites: Consent of instructor, graduate standing  
 Topics presented by a visiting professor or special lecturer. This will be used to develop new courses or to take advantage of special competence of resident or visiting faculty members.

## FOR GRADUATES ONLY

- MB 632 (SSC 632) ECOLOGY AND FUNCTIONS OF SOIL MICROORGANISMS** 3 (3-0) S
- MB 690 MICROBIOLOGY SEMINAR** 1 (1-0) F S
- MB 692 SPECIAL PROBLEMS IN MICROBIOLOGY** Credits Arranged F S
- MB 699 MICROBIOLOGY RESEARCH** Credits Arranged F S

# MILITARY EDUCATION & TRAINING

## AEROSPACE STUDIES (Air Force ROTC)

### GENERAL MILITARY EDUCATION

AS 121 AEROSPACE STUDIES 100 1 (1-1) F

This is the initial course of study in the four-year AFROTC curriculum. This course is designed to familiarize the student with the mission, organization and doctrine of the U. S. Air Force, U. S. Strategic Offensive Forces and introduction to U. S. Strategic Defensive Forces. Corps training provides the cadet with experience in executing drill movements, knowledge of customs and courtesies expected of an Air Force member, career opportunities in the Air Force, and the life and work of an Air Force junior officer.

AS 122 AEROSPACE STUDIES 100 1 (1-1) S

Prerequisite: AS 121 or equivalent

Continues the study of U. S. Strategic Defensive Forces, U. S. General Purpose and Aerospace Support Forces including those of the Army, Navy and Marines. Corps training continues to stress emphasis on basic fundamentals needed for the cadet to be capable of assuming and discharging his responsibilities in future AFROTC functions and as a professional officer.

AS 221 AEROSPACE STUDIES 200 1 (1-1) F

Prerequisite: AS 122 or equivalent

Study of the organization of the Department of Defense and the role of the military in national policies. Basic familiarization with defense policies including study of the nature and principles of war. General and limited warfare covered as preparation for future discussion of U. S. defense policies. Corps training continues to develop skills learned in AS 100 and furthers study of junior officer environment.

AS 222 AEROSPACE STUDIES 200 1 (1-1) S

Prerequisite: AS 221 or equivalent

Study involves survey of Soviet and Chinese military policy, role of alliances in U. S. defense policy, and some of the various elements and processes in the making of defense policy. Corps training continues to develop leadership skills and study of junior officer environment.

### PROFESSIONAL OFFICER EDUCATION PROGRAM

AS 321 AEROSPACE STUDIES 300 1 (3-1) F

Prerequisite: Four-year ROTC cadets, AS 222; two-year, nonveteran students, attendance at a six-week field training course

This course is designed to increase knowledge and awareness of important phases and personalities in the development of airpower. It begins with the first efforts in ballooning and ends in the early 1960s. Latter portions of the course emphasize organization growth and doctrinal development of today's Aerospace Forces. Considerable opportunity is given to practice communicative skills as an integral part of course activities. Leadership in military drill and command is practiced in the laboratory period.

AS 322 AEROSPACE STUDIES 300 2 (3-1) S

Prerequisite: AS 321

This is a study of astronautics and space operations. It is a relatively non-technical review of the national (U. S.) space effort, the spatial environment and space orbits and trajectories. Space vehicle systems including structures, propulsion, electric

power, guidance, communications, ground support and "Man in Space" are reviewed on the same nontechnical level. U. S. space operations and our future developments are also reviewed. Continued military leadership opportunities are provided in the laboratory period.

**AS 421 AEROSPACE STUDIES 400**

**1 (3-1) F**

Prerequisite: AS 322

Class and laboratory include an exploration and practical experience in the need for leadership and a study of human behavior and relations that relate to military leadership. Included is a study of the professional Air Force Officer, self-discipline and military law, plus an examination of the multiple variables affecting leadership. At all times emphasis is placed on the development of communicative skills and what the student needs to know as a future junior officer of the United States Air Force.

**AS 422 AEROSPACE STUDIES 400**

**2 (3-1) S**

Prerequisite: AS 421

Class and laboratory include a study and practical experience in military management functions. A study of the planning, organizing, directing, controlling, and coordinating function of management is made. At all times emphasis is placed on the development of communicative skills, leadership abilities and that knowledge necessary for a future junior officer of the United States Air Force.

**AS 499 FLIGHT INSTRUCTION PROGRAM GROUND SCHOOL**

**0 (3-0) S**

Prerequisite: None

This course presents material which develops aeronautical knowledge required by the Federal Aviation Administration (FAA) for private pilots. It familiarizes students with the appropriate general and visual flight rules of part 91 of the Federal Aviation Regulations; obtaining and evaluating of flight weather reports; flight planning elements such as plotting courses, estimating time enroute, and fuel requirements. This course is required in the Flight Instruction Program (FIP) for Air Force ROTC cadets.

## **FIELD TRAINING COURSES**

AFROTC field training is offered during the summer months at selected Air Force bases throughout the United States. Students in the four-year program participate in four weeks of field training during the summer after their sophomore year. Students applying for entry into the two-year program must successfully complete six weeks of field training prior to enrollment in AFROTC.

The major areas of study in the four-week field training program include junior officer training, aircraft and aircrew indoctrination, career orientation, survival training, base functions and Air Force environment and physical training.

The major areas of study included in the six-week field training program are essentially the same as those conducted in subject matter that four-year program students received in the General Military Course, including corps training, during their freshman and sophomore years of on-campus AFROTC enrollment.

## **MILITARY SCIENCE (Army ROTC)**

### **THE BASIC COURSE**

**MS 101 MILITARY SCIENCE I**

**1 (1-1) F**

A study of the organization and mission of the U. S. Army, to include the history of the ROTC Program. Practical work in individual weapons and marksmanship is included. Leadership laboratory emphasizes the development of teamwork, esprit de corps, and essential characteristics of leadership.

**MS 102 MILITARY SCIENCE I****1 (1-1) S**

A seminar approach which investigates current topics of interest to the Army such as drug use, race relations, and environmental concerns. Course also provides instruction in the definition, causes, and evolution of warfare. Leadership laboratory activities stress development of teamwork, esprit de corps, and essential characteristics of leadership.

**MS 201 MILITARY SCIENCE II****1 (2-1) F**

Prerequisites: MS 101, MS 102, or equivalent credits

An investigation of American military history, with emphasis on the U. S. Army's development and role in periods of peace and war. Time span covers from Colonial days through the present. Leadership laboratory emphasis is on development of teamwork, esprit de corps, essential characteristics of leadership, and acceptance of responsibility.

**MS 202 MILITARY SCIENCE II****1 (2-1) S**

Prerequisites: MS 101, MS 102, or equivalent

Instruction in map and aerial photograph reading; an introduction to the theory and dynamics of basic tactics, to include offensive and defensive operations at the small-unit level. Leadership laboratory will provide opportunity for practical application of knowledge gained in the classroom and will continue to emphasize the lab goals of MS 201.

**MS 301 MILITARY SCIENCE III****1 (2-1) F**

Prerequisites: MS I and MS II or equivalent credits

Classroom instruction in military leadership, emphasizing the factors controlling soldiers' behavior and the problems of command; methods of military instruction, with emphasis placed on the leader's responsibility for the soldier's learning; practical leadership instruction is provided during laboratory periods where emphasis is placed on acceptance of responsibility, exercise of command, and development of self-confidence.

**MS 302 MILITARY SCIENCE III****2 (2-1) S**

Prerequisites: MS 101-102, MS 201-202, or equivalent, MS 301

Classroom instruction in the missions and function of the various branches of the Army; principles of military planning and the conduct of offensive and defensive operations, to include communications in the military. Practical leadership instruction is provided during leadership laboratory activities, where emphasis is placed on acceptance of responsibility, exercise of command, and development of self-confidence.

**MS 401 MILITARY SCIENCE IV****1 (2-1) F**

Prerequisite: MS 301-302

A seminar approach in management of the military team, discussing organizational theory, the philosophy and historical development of military management concepts, operational techniques and staff procedures. Leadership laboratory periods emphasize the practical application of these techniques through the exercise of full command and staff responsibility in planning, providing logistical support, and executing all phases of field training and leadership development.

**MS 402 MILITARY SCIENCE IV****2 (2-1) S**

Prerequisite: MS 301, MS 302, MS 401

A seminar approach to leadership and management in the contemporary military environment discussing the problems of developing nations, the position of the United States on the world scene, and the leader's responsibility in the administration of military justice and management of personal affairs. Leadership laboratory periods continue to develop the practical experience begun in MS 401L, using week-

end field training exercises as the problem vehicle to prepare the cadet for subsequent commissioning and attendance at basic branch school upon entry on active military service.

## MODERN LANGUAGES

*NOTE: Two years of high school languages will normally be considered the equivalent of one year of college instruction in that language.*

### ENGLISH (Foreign Students)

MLE 101 ENGLISH FOR FOREIGN STUDENTS: REVIEW GRAMMAR 3 (3-0) F S

Emphasis in this course is laid upon the pronunciation, grammar and comprehension of American English.

MLE 102 ENGLISH FOR FOREIGN STUDENTS: COMPOSITION 3 (3-0) F S

Emphasis in this course is laid upon the writing of American English, grammatical exercises, sentence structure, spelling and diction.

MLE 103 ENGLISH FOR FOREIGN STUDENTS: CONVERSATION 3 (3-0) F S

Designed for foreign students who have studied formal English but who need oral practice in informal speech to understand it and speak it with ease and fluency. Emphasis is placed on correct pronunciation, intonation (rhythm and stress in words and sentences), drill on the basic patterns of English sentences and idiomatic expressions by means of oral classroom drills, conversations about current issues, and individual and/or supervised practice in the language laboratory.

### FRENCH

MLF 101 ELEMENTARY FRENCH I 3 (3-0) F S

MLF 102 ELEMENTARY FRENCH II 3 (3-0) F S  
Prerequisite: MLF 101 or equivalent

MLF 110 REVIEW GRAMMAR AND COMPOSITION 3 (3-0) F S  
Prerequisite: MLF 102 or equivalent

This course will bridge the gap between basic grammar courses and the more advanced literary courses preparing the student for the type of composition and conversation expected of him in the latter. It will also offer an opportunity for students with a previous knowledge of language from secondary schools to review grammar and obtain experience in an area not normally covered in high school work.

MLF 201 INTERMEDIATE FRENCH I 3 (3-0) F S  
Prerequisite: MLF 102 or equivalent

MLF 202 INTERMEDIATE FRENCH II 3 (3-0) F S  
Prerequisite: MLF 201

MLF 301 SURVEY OF FRENCH LITERATURE AND CIVILIZATION,  
ORIGINS TO 1800 3 (3-0) F S  
Prerequisite: Six hours intermediate French

MLF 302 SURVEY OF FRENCH LITERATURE AND CIVILIZATION,  
1800 TO PRESENT 3 (3-0) F S  
Prerequisite: Six hours intermediate French

MLF 309 ADVANCED FRENCH CONVERSATION AND PHONETICS 3 (3-0) F S  
Prerequisite: Six hours intermediate French or equivalent

MLF 310 ADVANCED FRENCH GRAMMAR 3 (3-0) F S  
Prerequisite: Six hours intermediate French or equivalent

MLF 322 FRENCH NOVEL BEFORE WORLD WAR II 3 (3-0) F S  
Prerequisite: Intermediate French

This course begins with the Post-Zola novelists and goes on to the novelists of the World War I period. The novels of Breton will be followed by the early works of André Malraux and Jean Paul Sartre. Lectures, written and oral reports.

MLF 323 CONTEMPORARY FRENCH NOVEL 3 (3-0) F S  
Prerequisite: Six hours intermediate French

MLF 324 THE CONTEMPORARY FRENCH THEATER 3 (3-0) F S  
Prerequisite: Intermediate French

A large number of representative plays of the period will be read and discussed. The ideas, philosophies, and trends initiated and followed by modern French dramatic authors will be examined in detail. Its relevance to contemporary U. S. theater will also be explored. A preliminary study will be made of the realistic theater and other developments in the theater of the late 19th century.

MLF 411 FRENCH LITERATURE OF THE 17TH CENTURY 3 (3-0) F S  
Prerequisite: Consent of instructor

MLF 412 FRENCH LITERATURE OF THE 18TH CENTURY 3 (3-0) F S  
Prerequisite: Consent of instructor

MLF 491 SPECIAL TOPICS IN FRENCH STUDIES 3 (3-0) F S  
Prerequisite: Consent of the department

MLF 492 SPECIAL TOPICS IN FRENCH STUDIES 3 (3-0) F S  
Prerequisite: Consent of the department

MLF 498 SPECIAL TOPICS IN FRENCH: INDEPENDENT STUDY 1-6 F S  
Prerequisite: Consent of the department

The student will make a detailed investigation of a special topic in language or literature. The topic and mode of study will be determined by the faculty member in consultation with the head of the Modern Language Department.

## FOR GRADUATE CERTIFICATION

*These courses do not carry undergraduate credit.*

MLF 401 SCIENTIFIC FRENCH FOR GRADUATE STUDENTS 3 (3-0) F S

This course is designed to present the grammar of scientific French as rapidly as possible in preparation for the reading course which follows.

MLF 402 SCIENTIFIC FRENCH FOR GRADUATE STUDENTS 3 (3-0) F S  
Prerequisite: MLF 401 or equivalent

Reading and translation of technical French.

## GERMAN

MLG 101 ELEMENTARY GERMAN I 3 (3-0) F S

MLG 102	ELEMENTARY GERMAN II	3 (3-0) F S
Prerequisite: MLG 101 or equivalent		
MLG 110	REVIEW GRAMMAR AND COMPOSITION	3 (3-0) F S
Prerequisite: MLG 102 or equivalent		
This course is for students with previous knowledge of a language from secondary schools to review grammar and obtain experience in an area not normally covered in their high school work.		
MLG 201	INTERMEDIATE GERMAN I	3 (3-0) F S
Prerequisite: MLG 102 or equivalent		
MLG 202	INTERMEDIATE GERMAN II	3 (3-0) F S
Prerequisite: MLG 201		
MLG 301	SURVEY OF GERMAN LITERATURE AND CIVILIZATION, ORIGINS TO 1900	3 (3-0) F S
Prerequisite: Six hours intermediate German		
MLG 302	SURVEY OF GERMAN LITERATURE AND CIVILIZATION, 1900 TO PRESENT	3 (3-0) F S
Prerequisite: Six hours intermediate German		
MLG 309	ADVANCED GERMAN CONVERSATION AND PHONETICS	3 (3-0) F S
Prerequisite: Six hours intermediate German or equivalent		
MLG 322	MAJOR GERMAN MODERN WRITERS	3 (3-0) F S
Prerequisite: Six hours intermediate German		
MLG 323	CONTEMPORARY GERMAN LITERATURE	3 (3-0) F S
Prerequisite: One year intermediate German		
MLG 498	SPECIAL TOPICS IN GERMAN: INDEPENDENT STUDY	1-6 F S
Prerequisite: Consent of the department		

### FOR GRADUATE CERTIFICATION

*These courses do not carry undergraduate credit.*

MLG 401	SCIENTIFIC GERMAN FOR GRADUATE STUDENTS	3 (3-0) F S
This course is open to graduate students and senior honorstudents and is designed to present the grammar of scientific German as rapidly as possible in preparation for the reading course which follows.		
MLG 402	SCIENTIFIC GERMAN FOR GRADUATE STUDENTS	3 (3-0) F S
Prerequisite: MLG 401 or equivalent		
Reading and translation of technical German.		

### ITALIAN

MLI 101	ELEMENTARY ITALIAN I	3 (3-0) F S
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MLI 102	ELEMENTARY ITALIAN II	3 (3-0) F S
Prerequisite: MLI 101 or equivalent		
MLI 201	INTERMEDIATE ITALIAN I	3 (3-0) F S
Prerequisite: MLI 102 or equivalent		
MLI 202	INTERMEDIATE ITALIAN II	3 (3-0) F S
Prerequisite: MLI 102 or equivalent		

## RUSSIAN

MLR 101	ELEMENTARY RUSSIAN I	3 (3-0) F S
MLR 102	ELEMENTARY RUSSIAN II	3 (3-0) F S
Prerequisite: MLR 101 or equivalent		
MLR 201	INTERMEDIATE RUSSIAN I	3 (3-0) F S
Prerequisite: MLR 102 or equivalent		
MLR 202	INTERMEDIATE RUSSIAN II	3 (3-0) F S
Prerequisite: MLR 102 or equivalent		

MLR 303 RUSSIAN LITERATURE IN TRANSLATION I 3 (3-0) F S  
 This course will offer a general introduction to Russian Literature of the 19th century so as to fill the gaps for students studying other European literature, or for students interested in Russian culture. Taught in English.

MLR 304 RUSSIAN LITERATURE IN TRANSLATION II 3 (3-0) F S  
 This course will offer a general introduction into Russian literature of the 20th century so as to fill the gaps for students studying other European literatures, or for students interested in Russian literature and culture in relation to the rest of Europe. Taught in English.

## SPANISH

MLS 101	ELEMENTARY SPANISH I	3 (3-0) F S
MLS 102	ELEMENTARY SPANISH II	3 (3-0) F S
Prerequisite: MLS 101 or equivalent		
MLS 110	REVIEW GRAMMAR AND COMPOSITION	3 (3-0) F S
Prerequisite: MLS 102 or equivalent		

This course will bridge the gap between basic grammar courses and the more advanced literary courses preparing the student for the type of composition and conversation expected of him in the latter. It will also offer an opportunity for students with previous knowledge of a language from secondary schools to review grammar and obtain experience in an area not normally covered in their high school work.

MLS 201 INTERMEDIATE SPANISH I 3 (3-0) F S  
 Prerequisite: MLS 102 or equivalent

MLS 202 INTERMEDIATE SPANISH II 3 (3-0) F S  
 Prerequisite: MLS 201

MLS 301 SURVEY OF SPANISH LITERATURE AND CIVILIZATION, 3 (3-0) F S  
 ORIGINS THROUGH GOLDEN AGE  
 Prerequisite: Six hours intermediate Spanish

MLS 302	SURVEY OF SPANISH LITERATURE AND CIVILIZATION, 1800 TO PRESENT	3 (3-0) F S
Prerequisite: Six hours intermediate Spanish		
MLS 303	LATIN AMERICAN LITERATURE I	3 (3-0) F S
Prerequisite: Six hours intermediate Spanish		
MLS 304	LATIN AMERICAN LITERATURE II	3 (3-0) F S
Prerequisite: Six hours intermediate Spanish		
MLS 309	ADVANCED SPANISH CONVERSATION AND PHONETICS	3 (3-0) F S
Prerequisite: Six hours intermediate Spanish or equivalent		
MLS 310	ADVANCED SPANISH GRAMMAR	3 (3-0) F S
Prerequisite: Six hours intermediate Spanish or equivalent		
MLS 323	CONTEMPORARY SPANISH LITERATURE	3 (3-0) F S
Prerequisite: Six hours intermediate Spanish		
MLS 403	CERVANTES	3 (3-0) F S
Prerequisite: MLS 301, 302 or equivalent		
MLS 404	DRAMA OF THE GOLDEN AGE	3 (3-0) F S
Prerequisite: MLS 301, 302 or equivalent		
MLS 491	SPECIAL TOPICS IN SPANISH STUDIES	3 (3-0) F S
Prerequisite: Consent of the department		
MLS 492	SPECIAL TOPICS IN SPANISH STUDIES	3 (3-0) F S
Prerequisite: Consent of the department		
MLS 498	SPECIAL TOPICS IN SPANISH: INDEPENDENT STUDY	1-6 F S
Prerequisite: Consent of the department		

### FOR GRADUATE CERTIFICATION

*These courses do not carry undergraduate credits.*

MLS 401	SCIENTIFIC SPANISH FOR GRADUATE STUDENTS	3 (3-0) F S
This course is designed to present the grammar of scientific Spanish as rapidly as possible in preparation for the reading course which follows.		
MLS 402	SCIENTIFIC SPANISH FOR GRADUATE STUDENTS	3 (3-0) F S
Prerequisite: MLS 401 or equivalent		
Reading and translation of technical Spanish.		

### MUSIC

MUS 100	INSTRUMENTAL MUSIC	1 (0-5) F S
Prerequisite: Satisfactorily passing audition		
Open to all students for the study and performance of the best in instrumental music. Assignments to the various organizations are made according to the interests and abilities of the individual.		
MUS 110	CHORAL MUSIC	1 (0-4) F S
Prerequisite: Satisfactorily passing audition		

Open to all students for the study and performance of the best in choral music. Assignments to the various organizations are made according to the interests and abilities of the individual.

**MUS 200 MUSIC IN CONTEMPORARY LIFE**

3 (3-0) F S

A course especially designed to assist students in developing their understanding of music as a vital part in today's life. Special emphasis on evaluating musical form and content, style periods, design and interpreting music as it relates to various aspects of today's society.

**MUS 210 A SURVEY OF MUSIC IN AMERICA**

3 (3-0)

Alternate Years

A survey of the music in the United States from colonial times to the present, with particular emphasis on the major influences which have shaped the musical literature and culture of America.

**MUS 215 MUSIC OF THE 17TH AND 18TH CENTURIES**

3 (3-0)

Alternate Years

A study of selected European music from 1600 to 1800 with particular emphasis on concepts of compositional style and a reflection of certain broad cultural tendencies as well as of purely musical phenomena. Study is made of specific forms and genres as they are transformed during the course of this period.

**MUS 220 MUSIC OF THE ROMANTIC PERIOD**

3 (3-0)

Alternate Years

A course designed to provide an insight into the significant musical trends of the Romantic Period (1800-1900). Subject matter will include an analysis of the prevailing musical forms, the styles of the composers, and the relation of music to other art forms.

**MUS 320 MUSIC OF THE 20TH CENTURY**

3 (3-0)

Alternate Years

A study of representative music from 1900 to the present. Emphasis is upon musical ideas and materials. The traditions and innovations, as exemplified in the music of this century are examined.

## **NUCLEAR ENGINEERING**

### **FOR ADVANCED UNDERGRADUATES**

**NE 201 APPLICATIONS OF NUCLEAR ENERGY**

3 (3-0) S

Prerequisite: PY 202

A general introduction to the uses of nuclear energy. Topics include radioactivity, fission, chain reaction, power production, isotopes, radiation detection, radiation safety, environmental effects, and energy resources. This course is intended to give the student a broad perspective of nuclear engineering and to introduce fundamental principles and concepts, and peaceful applications.

Mr. Murray

**NE 302 FUNDAMENTALS OF NUCLEAR ENGINEERING**

4 (3-2) S

Prerequisite: PY 410

An introductory course in nuclear engineering, aimed at preparing the student for further study in the field. Topics include neutron physics, reactor theory, reactor operations, radioisotope applications, and other nuclear methods. Particular emphasis is given to basic principles underlying the design and operation of nuclear systems, facilities and applications. Laboratory sessions include the various techniques of radiation detection and measurement, reactor nuclear instrumentation, and reactor measurements.

Mr. Stam

**NE 401 REACTOR ANALYSIS AND DESIGN****4 (3-2) S****Prerequisite:** NE 302 or NE 419

Elements of nuclear reactor theory, including neutron cross section behavior, transport theory, neutron slowing and diffusion, Fermi age theory, multigroup concepts, criticality of homogeneous reactors, and kinetics of simple systems. Observation and measurements of static and dynamic nuclear behavior, the effectiveness of control and temperature and correlation with theory. Experiments on the measurement of reactor-physics parameters.

**Mr. Stam****NE 402 REACTOR ENGINEERING****4 (3-2) F****Corequisite:** NE 401

Engineering topics pertinent to the design and operation of reactors are stressed. These include heat transfer in flowing fluids, power-plant systems, fuel cycles, power plant economics and reactor operations. Laboratories include reactor start-up and control, reactor kinetics, reactor and power-plant heat transfer and the monitoring of radioactivity in reactor effluents.

**Messrs. Bohannon, Zumwalt****NE 403 NUCLEAR ENGINEERING DESIGN PROJECTS****2 (1-3) S****Prerequisite:** NE 402

Student projects in design of practical nuclear engineering systems. Preliminary designs are developed by teams with advice by faculty as needed, and reports are presented in oral and written form. Current and future systems are emphasized, and use of computers is encouraged.

**Staff****NE 419 INTRODUCTION TO NUCLEAR ENGINEERING****3 (3-0) F S****Prerequisite:** PY 202 or PY 208

A survey of nuclear energy applications, including nuclear reactor materials, reactor theory, shielding, thermal and hydraulic analysis, and control. Uses of nuclear fission and its by-products in research, industry and propulsion are reviewed. The major engineering problems are defined and methods of approach are outlined. This course is designed for students in other departments.

**Mr. Gardner****NE 491, 492 NUCLEAR ENGINEERING TOPICS I, II****1-4 F S****Prerequisite:** Consent of instructor

These courses will provide detailed coverage of special topics in nuclear engineering. Typical topics: radiation applications, nuclear fuel cycles, reactor systems, radiological and reactor safety, and quality assurance. Intended as electives for nuclear engineering seniors and professional degree students and for qualified students from other curricula. Topics offered may change from semester to semester and from year to year, depending upon professional interest and developments in the field of nuclear engineering.

**Messrs. Gardner, Verghese, Bohannon****FOR GRADUATES AND ADVANCED UNDERGRADUATES****NE 501 REACTOR ANALYSIS****3 (3-0) F****Prerequisites:** NE 302 or NE 419

Elements of nuclear reactor theory, including neutron mechanics, spatial aspects, critical mass calculations, time behavior, spectral characteristics, multigroup and multiregion descriptions, heterogeneous systems, reactivity and reactor dynamics, perturbation theory, and neutron transport.

**Mr. Murray****NE 502 REACTOR DESIGN****3 (3-0) S****Prerequisite:** NE 501

Elements of nuclear reactor design and operation, including reactor materials, thermal and hydraulic analysis, control and safety, and thermal and fast reactor systems.

**Mr. Saxe**

NE 504 (MA 504) MATHEMATICAL METHODS IN ENGINEERING 3 (3-0) F  
(See mathematics, page 382.)

NE 505 EXPERIMENTAL METHODS IN NUCLEAR ENGINEERING 3 (1-4) S  
Prerequisites: NE 501, NE 511  
Corequisites: NE 502, NE 512

Laboratory experiments are performed to illustrate the principles and concepts covered in NE 501, NE 502, NE 511 and NE 512. Mr. Gardner

NE 511 (PY 511) NUCLEAR PHYSICS FOR ENGINEERS 3 (3-0) F  
(See physics, page 424.)

NE 512 RADIATION APPLICATIONS 3 (3-0) S  
Prerequisite: NE 511

Applications of radiation interaction principles to practical nuclear problems. Topics include radiological safety, effects of radiation on biological and structural materials and industrial applications of radioisotopes and radiation. Mr. Zumwalt

NE 562 (MAT 562) MATERIALS PROBLEMS IN NUCLEAR ENGINEERING 3 (3-0) F  
(See materials engineering, page 377.)

NE 573 (MAT 573) COMPUTER EXPERIMENTS IN MATERIALS ENGINEERING 3 (3-0) F  
Prerequisites: PY 407, MA 301

The basic techniques for constructing both statistical (Monte Carlo) and deterministic computer experiments will be explained and discussed from the standpoint of immediate use in the solution of current engineering research and development. Mr. Beeler

NE 574 (CE 574) ENVIRONMENTAL CONSEQUENCES OF NUCLEAR POWER 3 (3-0) S  
Prerequisite: Consent of instructor(s)

In this course, the environmental consequences resulting from the siting, construction, and operation of nuclear power plants are encountered. An understanding is sought of why more power plants are needed and of the environmental consequences of alternatives to nuclear power. Subjects examined include: fuel sources; fuel reprocessing, sources and treatment of solid, liquid, gaseous wastes; the costs of minimizing wastes and the effects of rejected heat; beneficial uses of rejected heat; and pertinent federal and state regulations. Messrs. Kohl, Zumwalt, Smallwood

NE 591, 592 SPECIAL TOPICS IN NUCLEAR ENGINEERING I, II 3 (3-0) F S  
Prerequisite: Consent of instructor

## FOR GRADUATES ONLY

NE 601 REACTOR THEORY AND ANALYSIS 3 (3-0)

NE 602 ADVANCED REACTOR THEORY 3 (3-0)

NE 611 RADIATION DETECTION 3 (2-2)

NE 620 NUCLEAR RADIATION ATTENUATION 3 (3-0)

NE 621 RADIATION EFFECTS ON MATERIALS 3 (3-0)

NE 622 TRANSPORT OF MATTER IN NUCLEAR REACTORS 3 (3-0)

NE 631	REACTOR KINETICS AND CONTROL	3 (3-0)
NE 641	RADIOISOTOPE APPLICATIONS	3 (3-0)
NE 653	NUCLEAR REACTOR DESIGN	3 (3-0)
NE 691, 692	ADVANCED TOPICS IN NUCLEAR ENGINEERING, I, II	3 (3-0) F S
NE 695	SEMINAR IN NUCLEAR ENGINEERING	1 (1-0) F S
NE 699	RESEARCH IN NUCLEAR ENGINEERING	Credits Arranged F S

## NUTRITION

(See page 332.)

## OPERATIONS RESEARCH

OR 501	INTRODUCTION TO OPERATIONS RESEARCH	3 (3-0) F Sum.
Prerequisites: MA 405, MA 421		
Required for all operations research minors.		

OR Approach: Modeling, constraints, objective and criterion. The problem of multiple criteria. Optimization. Model validation. The team approach. Systems design. Examples. OR Applications: Theory of inventory: economic ordering under deterministic and stochastic demand. The production smoothing problem: linear and quadratic cost functions. Waiting line problems: single and multiple servers with Poisson input and output. The theory of games for two-person competitive situations. Project management through PERT-CPM.

Mr. Cooper

OR 505	(IE 505, MA 505) MATHEMATICAL PROGRAMMING I	3 (3-0) F Sum.
Prerequisite: MA 405		

A study of mathematical methods applied to problems of planning. Linear programming will be covered in detail. This course is intended for those who desire to study this subject in depth and detail. It provides a rigorous and complete development of the theoretical and computational aspects of this technique as well as a discussion of a number of applications.

Staff

OR 509	(IE 509) DYNAMIC PROGRAMMING	3 (3-0) S Sum.
Prerequisites: MA 405, ST 421		

An introduction to the theory and computational aspects of dynamic programming and its application to sequential decision problems.

Mr. Nuttle

OR 520	THEORY OF ACTIVITY NETWORKS	3 (3-0) S
Prerequisites: OR 501, OR 505		

Introduction to graph theory and network theory. A discussion in depth of the theory underlying (i) deterministic activity networks (CPM): optimal time-cost trade offs; the problem of scarce resources; (ii) probabilistic activity networks (PERT): critical evaluation of the underlying assumptions; (iii) generalized activity networks (GERT, GAN): applications of signal flow graphs and semi-Markov process to probabilistic branching; relation to the theory of scheduling.

Mr. Elmaghraby

OR 522	(IE 522) DYNAMICS OF INDUSTRIAL SYSTEMS	3 (3-0) S
(See industrial engineering, page 369.)		

OR 527	(CHE 527) OPTIMIZATION OF ENGINEERING PROCESSES	3 (3-0) F
(See chemical engineering, page 270.)		

OR 561 (IE 561) QUEUES AND STOCHASTIC SERVICE SYSTEMS 3 (3-0) F  
Prerequisite: MA 421

Basic concepts of stochastic processes are introduced: Poisson processes, Markov processes, and renewal theory. These are then used in the analysis of queues, starting with a completely memoryless queue to one with general parameters. Applications to many engineering problems are considered. Mr. Magazine

OR 586 (IE 586) NETWORK FLOWS 3 (3-0) S  
Prerequisites: OR 505 (IE 505, MA 505)

This course will study problems of flows in networks. These problems will include the determination of the shortest chain, maximal flow, and minimal cost flow in networks. The relationship between network flows and linear programming will be developed as well as problems with nonlinear cost functions, multi-commodity flows, and the problem of network synthesis. (Offered in alternate years.)

Mr. Bennington

OR 606 (MA 606, ST 606) MATHEMATICAL PROGRAMMING II 3 (3-0) S

OR 609 ADVANCED DYNAMIC PROGRAMMING 3 (3-0) F

OR 631, 632 (EM 631, 632) VARIATIONAL METHODS IN OPTIMIZATION  
TECHNIQUES I, II 3 (3-0) F S

OR 691 SPECIAL TOPICS IN OPERATIONS RESEARCH 3 (3-0) F S Sum.

OR 692 (IE 692, MA 692) SPECIAL TOPICS IN MATHEMATICAL  
PROGRAMMING 3 (3-0) F S Sum.

OR 695 SEMINAR IN OPERATIONS RESEARCH 1 (1-0) F S

OR 699 PROJECT IN OPERATIONS RESEARCH 1-3 F S Sum.

## PHILOSOPHY (Also see Religion)

### FOR UNDERGRADUATES

PHI 201 LOGIC 3 (3-0) F S

This is an introductory course in the methods of deductive inference. The concepts of validity and implication are defined and applied to statements and arguments. Various techniques are used to determine validity and implication in both truth-functional logic and quantificational logic. Staff

PHI 205 PROBLEMS AND TYPES OF PHILOSOPHY 3 (3-0) F S

This is an introductory course, and the matters discussed will always be those with a history of importance in philosophy, such as problems concerning God, freedom, justice, and the nature and objects of human knowledge. Staff

PHI 300 EARLY WESTERN PHILOSOPHY 3 (3-0) F

This course traces the philosophical movements of Western Civilization from the pre-Socratics of ancient Greece, in whom Western philosophy had its origins, to the scientific revolution of the 17th century. The course especially emphasizes the works of Plato and Aristotle. Mr. Lear

PHI 301 MODERN WESTERN PHILOSOPHY 3 (3-0) S

This course consists of a critical survey of selected works of the major Western

philosophers from the 17th century to the 20th century, Descartes, Spinoza, Locke, Hume, Hegel, and Kant. The course will also include an adumbration of the trends taken by philosophy in the 20th century. Staff

PHI 304 (ED 304) PHILOSOPHY OF EDUCATION 3 (3-0) F S

This course explores the fundamental philosophical questions concerning education—namely, “What should we teach people, how should we teach it, and why?” The course is further concerned with exploring the very concepts of teaching and learning. Mr. Bryan

PHI 305 PHILOSOPHY OF RELIGION 3 (3-0) F S

This course combines two approaches to the philosophy of religion: phenomenological and analytic. The first is concerned to investigate and describe the subjective experiences of religion; the second analyzes and appraises language about religion. Given this dual approach, the course deals with the questions of the existence of God and of the language about God, including such traditional problems as verification, meaning, reference, myth, symbol, evil, immortality, and creation. Mr. Stalnaker

PHI 306 PHILOSOPHY OF ART 3 (3-0) F S

The general objective of this course is to analyze concepts and theories encountered in discussions of art in such a way as to illuminate the nature of works of art, esthetic experiences, and art criticism. Special attention is given to such concepts as creation, expression, intention, interpretation, communication, and evaluation, and to the problems and fallacies which seem to be involved in the use of these concepts. Mr. Bredenberg

PHI 307 MORALITY AND HUMAN HAPPINESS 3 (3-0) F

This course raises questions about the relationship between morality and happiness—one’s own and that of others. Accordingly, it explores both the nature of human happiness and the nature of justification of moral rights and obligations, if human beings have such rights and obligations. Mr. Regan

PHI 308 CONTEMPORARY MORAL PHILOSOPHY 3 (3-0) S

Many 20th century philosophers have asked what can be meant by ethical terms like “good,” “bad,” “right,” and “wrong.” They have asked how value judgments can be justified or shown to be valid. This course explores such questions, as well as some specific moral issues to which 20th century philosophers have turned their attention. Mr. Regan

PHI 309 CONTEMPORARY POLITICAL PHILOSOPHY 3 (3-0) F S

This course focuses on current discussions of basic concepts in political philosophy, such as liberty, equality, justice, natural rights, and democracy, with the aim of clarifying and resolving disputes concerning the relation of the individual to the state, the possibility of a tyranny of the majority in a democracy, and the use of justification of moral principles in political philosophy. Mr. VanDeVeer

PHI 310 EXISTENTIALISM 3 (3-0) F S

Existentialism is a major type of recent philosophy which has greatly influenced contemporary art, literature, and religion. This course traces the central existentialist motifs in the work of Kierkegaard, Nietzsche, Heidegger, Sartre, and others, and shows their influence upon contemporary culture. Mr. Fitzgerald

PHI 317 PHILOSOPHY FROM DESCARTES THROUGH HUME 3 (3-0) F

Modern philosophy is said to begin with Descartes in the 17th century. This course traces philosophic thought from Descartes through Spinoza and Leibniz on

the continent of Europe to the 18th century British empiricists, Locke, Berkeley, and Hume. Mr. Metzger

PHI 318 PHILOSOPHY FROM KANT TO THE PRESENT 3 (3-0) S  
Prerequisite: PHI 317 or consent of department

In spite of the variety and individuality of the philosophic thought from Kant to the present, the influence of Kant can be discerned in many directions. Depending on what they accepted in his philosophy, German idealists like Hegel and Schopenhauer take one general direction. The Logical Positivists, G. E. Moore, and Bertrand Russell take another. This course traces and explores some of the important roads leading from Kant. Mr. Metzger

PHI 330 METAPHYSICS 3 (3-0) S

This course consists of an examination of metaphysical problems and questions, most of which have classical origins but which will usually be treated from a contemporary perspective. Typical problems are those connected with appearance and reality, free-will and determinism, mind and body, and space and time. Staff

PHI 331 PHILOSOPHY OF LANGUAGE 3 (3-0) F

This course is concerned with the study of language by philosophers in the modern analytic tradition. It will examine both some traditional philosophical questions, such as the nature of necessity, which have led philosophers to the study of language, and some of the accomplishments and techniques of the philosophical study of language, especially meaning. Mr. Levin

PHI 333 THEORY OF KNOWLEDGE 3 (3-0) F

The objectives of this course include the analysis of such central concepts as knowledge, belief, and truth, and the investigation of the main kinds of knowledge and of the principles by which claims to know may be justified. Special attention is given to the problems involved in our claims to knowledge of the world through the evidence of the senses. Mr. Brendenberg

PHI 335 SYMBOLIC LOGIC 3 (3-0) F S

This course is an introduction to modern symbolic logic. In part it examines the procedures for the translation of certain English sentences into logical notation and for the manipulation of that notation, so as to produce correct inferences in it. The course is also an introduction to the mathematical study of logic, i.e., of the properties of the symbolic system itself. Messrs. Gillmor, Levin

PHI 402 ADVANCED LOGIC 3 (3-0) S  
Prerequisite: PHI 335 or permission of instructor

As a formal study of the notions of truth and provability, this course emphasizes some of the theorems of mathematical logic having philosophical importance—Godel's incompleteness results and Church's theorem, for example. The course also provides an introduction to recursive function theory. Mr. Gillmor

PHI 403 FOUNDATIONS AND PHILOSOPHY OF MATHEMATICS 3 (3-0) S  
Prerequisite: PHI 335 or permission of instructor

This course explores the alternative epistemological bases of mathematics provided by constructivism, intuitionism, formalism, and logicism. Some of the alternative foundations compatible with the various positions—e.g., the various axiomatic set theories and category theory—are also discussed. Mr. Gillmor

PHI 405 PHILOSOPHY OF SCIENCE 3 (3-0) F S

This course is concerned with the character and function of "explanation" in scientific activity. It examines the concepts of law and theory and seeks to establish the kind of claims to knowledge that scientific activity is entitled to advance. The role

of inductive confirmation is examined, and the relationship between natural and social science is explored. Mr. Levin

**PHI 490 SEMINAR IN PHILOSOPHY**

3 (3-0) F S

Prerequisite: Six credits in philosophy

The seminars are devoted to special studies in contemporary philosophy, with emphasis on research and critical analysis. Students entering the seminars are expected to be familiar with the major doctrines of modern western philosophy.

Staff

**PHI 492 PHILOSOPHY SEMINARS ON THE HUMAN CONDITION**

3 (3-0) F S

The seminars will be directed not only to scrutinizing in a philosophical way the so-called "Big Issues" like violence, civil disobedience, capital punishment, poverty, abortion and euthanasia, automation and cybernetics, and the quality of the environment; but also to exploring in a philosophical way the myriad dimensions and delicate subtleties of human experience like humor, eccentricity, fear, national differences, toleration, pornography, drugs, nostalgia. Each seminar will consider a natural cluster of such topics.

Staff

**PHI 498 SPECIAL TOPICS IN PHILOSOPHY**

1-6 F S

Prerequisite: Six hours philosophy

This course has no fixed description and is used to offer areas of study which appear only rarely in the curriculum. It will also function as a readings course for honors students in philosophy.

Staff

**PHI 499 SENIOR ESSAY IN PHILOSOPHY**

3 F S

Prerequisite: Consent of the department

The course work consists of individually directed research on a topic chosen in consultation with a staff adviser. The objective is a critical, written analysis of a well-defined topic in the thought of a major philosopher or in the literature of one of the main problems of philosophy.

Staff

**PHI 590 (EM 590, REL 590) TECHNOLOGY AND HUMAN VALUES**

3 (0-3) F S

Prerequisites: A baccalaureate degree in a recognized field of engineering, liberal arts, science or social science; or, for advanced undergraduates in these fields, two or more courses such as Technology in History (HI 341), Science and Civilization (UNI 301, 302), Contemporary Issues (UNI 401), or six credit hours in philosophy

The purposes of the course are: (1) To explore from two or more disciplinary perspectives (notably those of ethical theory and cybernetic information theory) the range of possible ways of conceptualizing the relationship between the technologies of a society and the values of that society; (2) In areas of particular interest to students, to analyze in detail contemporary instances of the interrelation of technology and human values.

Staff

## **PHYSICAL AND MATHEMATICAL SCIENCES**

### **FOR UNDERGRADUATES**

**PMS 100 ORIENTATION**

Prerequisite: Required of all freshmen in the School of Physical and Mathematical Science

Introduction to the field of the physical sciences and mathematics.

Staff

# PHYSICAL EDUCATION

## PREScribed COURSES

PE 100 HEALTH AND PHYSICAL FITNESS 1 (0-2) F

A lecture laboratory course designed to assess and improve the individual's physical fitness; and to convey essential health/fitness knowledge related to the activity continuum.

PE 112 BEGINNING SWIMMING I 1 (0-2) F S

A course for nonswimmers which is designed for meeting the University swimming requirements.

PE 113 BEGINNING SWIMMING II 1 (0-2) F S

A course for very weak swimmers. It is designed for meeting the University swimming requirement (and for preparing the student to take the intermediate swimming course).

PE 118 RESTRICTED ACTIVITY I 1 (0-2) F S

A course designed specifically to meet the needs of those individuals who have temporary or permanent physical impairments. Students entering this program must obtain a restrictive form from the Student Health Service.

PE 119 RESTRICTIVE ACTIVITY II 1 (0-2) F S

Prerequisite: PE 118

This course is a follow-up of PE 118.

## CONTROLLED ELECTIVE COURSES AQUATICS

PE 221 INTERMEDIATE SWIMMING 1 (0-2) F S

A course designed to give the student competence in four basic strokes and two dives.

PE 222 WATER SPORTS 1 (0-2) S

A course to teach the skills of water polo and water basketball, plus improvement in stamina and water skills.

PE 223 SENIOR LIFE SAVING 1 (0-2) F S

Prerequisite: PE 221 or equivalent

A course designed to qualify students for a Senior Red Cross Life Saving certificate.

PE 224 WATER SAFETY INSTRUCTORS 1 (0-2) F S

Prerequisite: PE 223 or equivalent

A course designed to qualify students for a Red Cross Water Safety Instructor's rating.

PE 225 SCUBA DIVING 1 (0-2) F S

Prerequisite: Demonstrate swimming proficiency

A course designed to instruct students in the appropriate and safe use of scuba diving equipment and related in-water skills. The knowledge and experience gained in this course should enable students to safely participate in scuba diving.

## COMBATIVES

### PE 232 PERSONAL DEFENSE

1 (0-2) F S

To promote mastery of fear that may arise from the anticipation of violent personal contact and to equip students with the techniques for personal defense. To include falls, throws, counters, locks, escapes.

### PE 233 BOXING

1 (0-2) F S

A course designed to acquaint the student with the fundamentals, skills, history and rules, with special emphasis on defensive techniques.

### PE 238 WRESTLING

1 (0-2) F S

A course designed to teach the fundamental skills, history and rules of wrestling and the values of regular exercise.

## DEVELOPMENTAL ACTIVITIES

### PE 117 GYMNASTICS I

1 (0-2) F S

A course designed for teaching the fundamentals of gymnastics on the parallel bars, side horse, trampoline and mats.

### PE 231 BODY MECHANICS I (WOMEN)

1 (0-2) F S

A course designed to direct the student in a program of physical development and coordinated movement.

### PE 234 GYMNASTICS II

1 (0-2) F S

Prerequisite: PE 117 or equivalent

This course is a follow-up of PE 117 with a primary emphasis on leadership training.

### PE 236 TRACK AND FIELD

1 (0-2) F S

A course designed to develop knowledge, skill and interest in track and field events.

### PE 237 WEIGHT TRAINING

1 (0-2) F S

A course designed for teaching the basic skills of body development through weight training. The student should gain knowledge of the principles of strength development and improve himself physically.

### PE 239 MODERN DANCE (WOMEN)

1 (0-2) F S

A course designed for each student to gain knowledge, skill and application of modern dance. It emphasizes the basic fundamentals of body movement executed to music.

## INDIVIDUAL SPORTS

### PE 241 ANGLING

1 (0-2) F S

A course designed to teach the fundamental skills of spin, fly and bait casting and an understanding of game fishing.

### PE 242 BADMINTON

1 (0-2) F S

A course designed to give the beginner skill in the basic strokes and a general knowledge of the history, rules and strategy of the game.

- PE 243 BOWLING** 1 (0-2) F S  
The fundamentals of ball selection, grips, stance and delivery are taught along with rules, history, scoring and the general theory of spare coverage.
- PE 244 FENCING** 1 (0-2) F S  
A course designed to teach the basic fundamentals, skills, techniques and rules of fencing.
- PE 245 GOLF** 1 (0-2) F S  
A course designed for teaching beginners the grip, stance, swing and use of the various clubs, along with the history and etiquette of play.
- PE 246 HANDBALL** 1 (0-2) F S  
A course designed to include the fundamental skills, together with the history and rules of handball.
- PE 247 ROLLER SKATING** 1 (0-2) F S  
A course designed to teach the fundamental skills of roller skating, with the emphasis on balance and speed.
- PE 248 SQUASH** 1 (0-2) F S  
A course designed to include the fundamental skills, together with the history and rules of squash.
- PE 249 TENNIS I** 1 (0-2) F S  
A course designed to give beginners a thorough knowledge of the history, rules and strategy as well as the fundamental skills of tennis.
- PE 250 TENNIS II** 1 (0-2) F S  
Prerequisite: PE 249 or equivalent  
This course is a follow-up of PE 249 with emphasis on game strategy and doubles play.
- PE 251 TARGET ARCHERY** 1 (0-2) F S  
A course designed to teach the fundamental skills of target archery and the selection and care of archery equipment.

## **TEAM SPORTS**

- PE 116 SOCCER** 1 (0-2) F  
A course designed to acquaint the student with the fundamental skill of the game and to offer the values of a vigorous outdoor team sport.
- PE 261 BASKETBALL** 1 (0-2) F S  
A course designed to teach the history, rules and strategy as well as the fundamental skills of basketball.
- PE 262 BASKETBALL (WOMEN)** 1 (0-2) F S  
A course designed to teach girls the history, rules and strategy as well as the fundamental skills of basketball.
- PE 263 FIELD HOCKEY (WOMEN)** 1 (0-2) S  
A course designed to teach girls the history, rules and strategy as well as the fundamental skills of field hockey.

**PE 264 SOCCER (WOMEN) 1 (0-2) F**

A course designed to teach girls the history, rules and strategy as well as the fundamental skills of soccer.

**PE 265 SOFTBALL 1 (0-2) S**

A course designed to include the fundamental skills, history and rules of the game.

**PE 267 TOUCH FOOTBALL 1 (0-2) F**

A course designed to include the fundamental skills, history, rules and strategy of touch football.

**PE 268 TOUCH FOOTBALL (WOMEN) 1 (0-2) F**

A course designed to teach girls the fundamental skills, history, rules and strategy of the game.

**PE 269 VOLLEYBALL 1 (0-2) F S**

A course designed to include the fundamental skills, history, rules and strategy of the game.

## **VARSITY SPORTS**

**PE 271 VARSITY SPORTS I 1 (0-2) F S**

This course is for students who are transferring to a varsity sport for a term (eight weeks) for the first time.

**PE 272 VARSITY SPORTS II 1 (0-2) F S**

This course is for students who are making their second transfer to a varsity sport.

**PE 273 VARSITY SPORTS III 1 (0-2) F S**

This course is for sophomores or those students who have received credit for two semesters of physical education and are transferring to a varsity sport.

**PE 274 VARSITY SPORTS IV 1 (0-2) F S**

This course is for sophomores or those students who have received credit for two semesters of physical education and are making their second transfer as a sophomore.

## **PHYSICAL OCEANOGRAPHY**

### **FOR UNDERGRADUATES**

**OY 200 (MAS 200) INTRODUCTION TO THE MARINE ENVIRONMENT 3 (3-0) F S**

Prerequisites: High school physics, chemistry, algebra, trigonometry, and biology, or equivalent

A descriptive account of the ocean as a part of our environment; subjects covered include interactions between atmosphere and ocean, ocean circulation, physical and chemical properties of sea water, marine geology, and marine biology.

**OY 487 (CE 487, MAS 487) PHYSICAL OCEANOGRAPHY 3 (3-0) S**

Prerequisites: MA 202, PY 212

An introduction, on an advanced level, to the principles of physical oceanography. Subjects to be covered are: history of physical oceanography; the geological and astronomical background for the field; tides and waves; fluid mechanics; characteristics of sea water; advective and convective processes; current measurements; laboratory models; and specific problems in physical oceanography.

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

OY 541	(MAS 541, CE 541)	GRAVITY WAVE THEORY I	3 (3-0) S
(See marine sciences, page 373.)			
OY 551	(MAS 551)	OCEAN CIRCULATION	3 (3-0) S
(See marine sciences, page 373.)			

## FOR GRADUATES ONLY

OY 601	(MAS 601)	ADVANCED PHYSICAL OCEANOGRAPHY I	3 (3-0) F
OY 602	(MAS 602)	ADVANCED PHYSICAL OCEANOGRAPHY II	3 (3-0) S
OY 605	(MAS 605, EM 605)	ADVANCED GEOPHYSICAL FLUID MECHANICS I	3 (3-0) F
OY 606	(MAS 606, EM 606)	ADVANCED GEOPHYSICAL FLUID MECHANICS II	3 (3-0) S
OY 613	(MAS 613, EM 613)	PERTURBATION METHOD IN FLUID MECHANICS I	3 (3-0) F
OY 614	(MAS 614, EM 614)	PERTURBATION METHOD IN FLUID MECHANICS II	3 (3-0) S
OY 699	RESEARCH IN PHYSICAL OCEANOGRAPHY		1-6 F S

## PHYSICS

### FOR UNDERGRADUATES

PY 201, 202, 203	GENERAL PHYSICS	4 (3-3) F S
Prerequisite: MA 102		

This sequence is intended primarily for majors in the departments of the School of Physical and Mathematical Sciences and the Department of Nuclear Engineering. Calculus is used throughout as needed. These courses are intended to give a good foundation for further study in the physical sciences.

Staff

PY 205, 208	GENERAL PHYSICS	4 (3-3) F S
Prerequisite: MA 102		

This sequence is required in most engineering curricula. A study of classical and modern physics in which the analytical approach is employed and calculus is applied as needed. Demonstration lectures, recitations, problem drill and laboratory work are coordinated to give a working knowledge of basic principles. PY 205, mechanics, sound and heat; PY 208, electricity, light and modern physics.

Staff

PY 211, 212	GENERAL PHYSICS	4 (3-2) F S
Prerequisite: MA 111 or MA 116		

These courses are designed for curricula requiring a basic though not specialized knowledge of physics. Lecture-demonstration, recitation and laboratory are coordinated to give a working familiarity with basic principles of mechanics, heat, sound, light, electricity and modern physics.

Staff

**PY 221 COLLEGE PHYSICS****5 (5-0) F S****Prerequisite: MA 111**

An introduction to the fundamental principles of physics and the many applications to modern science and technology. The important concepts in the classical areas of physics are presented, along with a brief survey of modern atomic physics. Lectures and demonstrations with class participation.

**Staff****PY 223 ASTRONOMY AND ASTROPHYSICS****3 (3-0) S**

A survey course at the introductory level. The development of astronomical thought is reviewed, followed by a study of the solar system, stellar evolution and current cosmological theories. Observational methods and techniques of measurement are taught along with a review of the underlying physical principles.

**Mr. Jenkins****PY 231 FOUNDATIONS OF PHYSICS****5 (5-0) F S****Prerequisite: MA 111 or MA 115**

A one-semester survey course concerned with the philosophy, the methods and the fundamental concepts of physics. The student will be introduced to Newtonian particle mechanics, conservation concepts, kinetic theory of matter, thermodynamics, wave phenomena, electricity and magnetism, principles of relativity, quantum concepts, and some atomic and nuclear phenomena.

**Mr. Seagondollar****FOR ADVANCED UNDERGRADUATES****PY 401, 402 MODERN AND QUANTUM PHYSICS I, II****3 (3-0) F S****Prerequisite: PY 411**

An introductory treatment of the basic theories of modern physics, particularly relativity and quantum mechanics, together with application of these theories to the study of atomic structure, optical spectra, X-rays, nuclear physics, solid state physics and elementary particles.

**Mr. Jenkins****PY 407 INTRODUCTION TO MODERN PHYSICS****3 (3-0) F S****Prerequisites: MA 202, PY 208**

A survey of the important developments in atomic and nuclear physics of this century. Among topics covered are: an introduction to special relativity, atomic and molecular structure, determination of properties of ions and fundamental particles, the origin of spectra, and nuclear reactions.

**Staff****PY 409 ION AND ELECTRON PHYSICS****3 (2-3) S****Prerequisite: PY 414**

Topics covered include collision processes in gases, electron emission, charged particle dynamics, gaseous discharges, and the physics of electron and ion beams.

**Mr. Bennett****PY 410 NUCLEAR PHYSICS I****4 (3-2) F S****Prerequisite: PY 203 or PY 407**

An introduction to the properties of the nucleus, and the interaction of radiation with matter. A quantitative description is given of natural and artificial radioactivity, nuclear reactions, fission, fusion and the structure of simple nuclei.

**Mr. Tilley****PY 411, 412 MECHANICS I, II****3 (3-0) F S****Prerequisites: MA 301, PY 203 or PY 208**

A sequence of courses in intermediate theoretical mechanics, including the dynamics of particles and rigid bodies, gravitation and moving reference systems.

An introduction is given to advanced mechanics, including Lagrangian and Hamiltonian dynamics. Mr. Mitchell

PY 413 THERMAL PHYSICS 3 (3-0) S  
Prerequisite: PY 202 or PY 208  
Corequisite: MA 301

An introduction to the statistical study of macroscopic systems. Topics covered include basic concepts of probability, the microscopic states of large systems, the concepts of temperature, heat and entropy, and the relations between these quantities. Mr. Lynn

PY 414, 415 ELECTRICITY AND MAGNETISM I, II 3 (3-0) F S  
Prerequisite: PY 203 or PY 208  
Corequisite: MA 512

An intermediate course in the fundamentals of static and dynamic electricity and electromagnetic theory, developed from basic experimental laws. Vector methods are introduced and employed throughout the course. Mr. Doggett

PY 416 PHYSICAL OPTICS 3 (2-2) S  
Prerequisite: PY 415

An intermediate course in physical optics with the major emphasis on the wave properties of light. Subjects covered include boundary conditions, optics of thin films, interference and diffraction, with applications to absorption, scattering and laser operation. Mr. Manring

PY 443 ASTROPHYSICS 3 (3-0) S  
Prerequisites: PY 203 or PY 407; PY 411

A survey of the basic physics necessary to investigate, from observational data, the internal conditions of stars and their evolution. Topics to be considered will include the formation and structure of spectral lines, methods of energy generation and transport, stellar structure, degeneracy and white dwarfs. Mr. Danby

PY 451, 452 INTERMEDIATE EXPERIMENTS IN PHYSICS I, II 2 (1-3) F S  
Corequisites: PY 411, PY 414

Experiments at the intermediate level in mechanics, electricity and magnetism, and modern physics. Mr. Martin

PY 499 SPECIAL PROBLEMS IN PHYSICS 1-3 F S  
Prerequisite: Consent of department

Study and research in special topics of classical and modern physics. A topic may be chosen for experimental or theoretical investigation, or a literature survey may be made. Staff

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

PY 501, 502 INTRODUCTION TO QUANTUM MECHANICS I, II 3 (3-0) F S  
Prerequisites: MA 512, PY 411 or PY 414

An introduction to the fundamental concepts and formulations of quantum mechanics, including its interpretation and techniques, and the application of the theory to simple physical systems, such as the free particle, the harmonic oscillator, the particle in a potential well and central force problems. Other topics include approximation methods, identical particles and spin, transformation theory, symmetries and invariance, and an introduction to quantum theory of scattering and angular momentum. Mr. Chung

PY 503, 504 INTRODUCTION TO THEORETICAL PHYSICS I, II 3 (3-0) F S  
Prerequisites: MA 512, PY 412, PY 414

An introductory course in theoretical physics which offers preparation for advanced graduate study. Emphasis is on classical mechanics, special relativity and the motion of charged particles. Topics covered include variational principles, Hamiltonian dynamics and the canonical transformation theory, structure of the Lorentz group and elementary dynamics of unquantized fields. Mr. Katzin

PY 507 ADVANCED ATOMIC PHYSICS 3 (3-0) F  
Prerequisites: MA 512, PY 412, PY 415

An introduction to the quantum mechanical treatment of atomic structure and spectra. Topics covered include the relativistic hydrogen atom, the helium atom, multielectron atoms, selection rules, etc. Mr. Memory

PY 509 PLASMA PHYSICS 3 (3-0) F  
Prerequisite: PY 414

A study of the individual and collective motion of charged particles in electric and magnetic fields and through ionized gases, including the pinch effect and induced processes in relativistic streams; transport equations; and properties of plasmas, including wave production and propagation, instabilities, shocks, and radiation losses, with applications. Mr. Bennett

PY 510 NUCLEAR PHYSICS II 4 (3-2) F  
Prerequisite: PY 410

A study of the properties of the atomic nucleus as revealed by radioactivity, nuclear reactions and scattering experiments, with emphasis on the experimental approach. The laboratory is designed to stimulate independent research and offers project work in nuclear spectroscopy and in neutron physics. Mr. Waltner

PY 511 (NE 511) NUCLEAR PHYSICS FOR ENGINEERS 3 (3-0) F  
Prerequisite: PY 410

A study of the properties of atomic nuclei, of nuclear radiations and of the interaction of nuclear radiation with matter. Emphasis is placed on the principles of modern equipment and techniques of nuclear measurement and their application to practical problems. Mr. Waltner

PY 514, 515 ADVANCED ELECTRICITY AND MAGNETISM I, II 3 (3-0) F S  
Prerequisite: PY 415

An advanced treatment of electricity and magnetism and electromagnetic theory. Topics include: techniques for the solution of potential problems, development of Maxwell's equations; wave equations; energy, force and momentum relations of an electromagnetic field; covariant formulation of electrodynamics; radiation from accelerated charges. Mr. Hall

PY 517 MOLECULAR SPECTRA 3 (3-0) S  
Prerequisites: PY 407, PY 412; PY 507 recommended

Topics include the interpretation of infrared and Raman spectra for diatomic and simple polyatomic molecules; the effects due to vibration-rotation interaction, electronic motion and nuclear spin; nuclear magnetic resonance spectroscopy; infrared absorption in the earth's atmosphere. Graduate Staff

PY 520 MEASUREMENTS IN NUCLEAR PHYSICS 3 (2-2) S  
Prerequisite: PY 410

A study of the fundamentals of statistics (including the binomial, normal, Poisson and interval distributions) as applied to the analysis of measurements on nuclear reactions and radioactivity. Mr. Waltner

PY 521 KINETIC THEORY OF GASES	3 (3-0) F
Prerequisite: PY 413	

A phenomenological and theoretical study of systems of dilute gases. After treatment of the continuum mechanics of fluids, the postulates of kinetic theory are presented and the derivation from them of macroscopic conservation equations, transport laws and thermodynamic properties is discussed.

Mr. Lado

PY 552 INTRODUCTION TO THE STRUCTURE OF SOLIDS	3 (3-0) S
Prerequisite: PY 401	

Basic considerations of crystalline solids, metals, conductors and semiconductors.

Mr. Schetzina

PY 555 (MA 555) MATHEMATICAL INTRODUCTION TO CELESTIAL MECHANICS	3 (3-0) F
(See mathematics, page 384.)	

PY 556 (MA 556) ORBITAL MECHANICS	3 (3-0) F
(See mathematics, page 384.)	

PY 599 SENIOR RESEARCH	3 F S
Prerequisite: Senior honors program standing, except with special permission	
Investigations in physics under the guidance of staff members, which may consist of literature reviews, experimental measurements or theoretical studies.	
	Graduate Staff

**FOR GRADUATES ONLY**

PY 600 PLANETARY ATMOSPHERES	3 (3-0) S
PY 601, 602 THEORETICAL PHYSICS I, II	3 (3-0) F S
PY 609 HIGH ENERGY PHYSICS	3 (3-0) S
PY 610 ADVANCED NUCLEAR PHYSICS	3 (3-0) F
PY 611 QUANTUM MECHANICS	3 (3-0) F
PY 612 ADVANCED QUANTUM MECHANICS	3 (3-0) S
PY 622 STATISTICAL MECHANICS	3 (3-0) S
PY 630, 631 NUCLEAR STRUCTURE PHYSICS I, II	3 (3-0) F S
PY 641 NON-INERTIAL SPACE MECHANICS	3 (3-0) S
PY 651 MATHEMATICS OF SOLID-STATE AND MANY-BODY THEORY	3 (3-0) F
PY 652 COOPERATIVE PHENOMENA IN SOLIDS	3 (3-0) S
PY 655 (MA 655) QUALITATIVE METHODS IN CELESTIAL MECHANICS	3 (3-0) F
PY 656 (MA 656) PERTURBATION THEORY IN CELESTIAL MECHANICS	3 (3-0) S
PY 690 SPECIAL TOPICS IN MOLECULAR PHYSICS	1-6 F S
PY 691 SPECIAL TOPICS IN NUCLEAR PHYSICS	1-6 F S

PY 692	SPECIAL TOPICS IN PLASMA PHYSICS	1-6 F S
PY 693	SPECIAL TOPICS IN SOLID-STATE PHYSICS	1-6 F S
PY 694	SPECIAL TOPICS IN THEORETICAL PHYSICS	1-6 F S
PY 695	SEMINAR	1 (1-0) F S
PY 699	RESEARCH	Credits Arranged F S

## PHYSIOLOGY

(See page 333.)

## PLANT PATHOLOGY

### FOR UNDERGRADUATES

PP 315	PLANT DISEASES	3 (2-3) F
Prerequisite: BS 100		

The nature and symptoms of disease in plants and the characteristics of important plant pathogenic nematodes, viruses, bacteria and fungi are studied. An understanding of the important concepts and methods of disease control is developed, based on a knowledge of major types of plant diseases. Messrs. Beute, Powell

PP 318 (FOR 318)	FOREST PATHOLOGY	3 (2-3) S
Prerequisite: BS 100 or equivalent		

The major types of diseases of forest trees and deterioration of wood products are studied with emphasis on: 1) economic impact on forest resources; 2) symptomology and diagnosis; 3) nature of pathogens and saprophytic microorganisms; 4) physiology, ecology and dissemination of causal organisms; 5) mechanisms of pathogenesis; 6) epidemiology and environmental influences; 7) principles of prevention and control. Messrs. Cowling, Grand

PP 319 (WPS 319)	BIOLOGICAL DETERIORATION OF WOOD	1 (2-3) S
Prerequisite: BS 100 or equivalent		

Biological deterioration of wood and its control are studied with emphasis on: 1) impact of various types of deterioration on economic values of wood products and on processes of wood utilization; 2) diagnosis of deterioration problems; 3) nature of the biological influences and microorganisms involved; 4) physiology of wood-inhabiting fungi and bacteria; 5) environmental influences on rates and type of deterioration; 6) prevention and control of deterioration of wood under various conditions of storage and use. Messrs. Cowling, Grand

### FOR GRADUATES AND ADVANCED UNDERGRADUATES

PP 500	PLANT DISEASE CONTROL	3 (2-3) S
Prerequisite: PP 315		

Disease control strategies and tactics are developed in a practical manner. Control economics and practices are considered in relation to principles and current research on biological, cultural, physical and chemical methods. Disease resistance and regulatory methods are also discussed. Messrs. Jenkins, Spurr

PP 501	PHYTOPATHOLOGY I	5 (3-6) F
Prerequisites: PP 315, or equivalent		

A study of the classification, terminology, etiology and basic concepts of plant

diseases caused by fungal, bacterial and abiotic agents. In-depth studies of carefully selected examples will be used to illustrate and integrate general principles. Laboratory sessions will be devoted to a consideration of research and diagnostic techniques including preparation of media, isolation and study of pathogens in pure culture, inoculation, symptom development and disease measurement.

Mr. Aycok

PP 502 PHYTOPATHOLOGY II 5 (3-6) S  
Prerequisites: PP 315, or equivalent

A study of viruses and nematodes as plant pathogens together with an overall consideration of such major topics as physiology of the diseased plant, variation of plant pathogens, epidemiology, and control of plant disease. Laboratory sessions will consider useful research and diagnostic techniques used in the study of viruses, nematodes, epidemiology and control.

Mr. Powell

PP 503 IDENTIFICATION OF PLANT PATHOGENIC FUNGI 3 (4-12) Sum.  
Prerequisite: Mycology or one advanced course in plant pathology

A study of the recognition and identification of fungi which cause plant diseases and the differentiation of fungal diseases from those caused by other agents. Special consideration will be given to use of keys in the identification of fungi and the major sources of descriptive information on plant pathogens. (Offered summer 1974 and alternate years.)

Mr. Hodges

PP 507 (MB 507) PATHOGENIC MICROBIOLOGY 4 (3-2) F  
(See microbiology, page 399.)

PP 575 (BO 575, MB 575) THE FUNGI 3 (3-0) S  
(See botany, page 266.)

PP 576 (BO 576, MB 576) THE FUNGI—LAB 1 (0-3) S  
(See botany, page 266.)

PP 595 SPECIAL PROBLEMS IN PLANT PATHOLOGY Credits Arranged  
Maximum 6

Prerequisite: Consent of instructor

Investigation of special problems in plant pathology not related to a thesis problem. The investigation may consist of original research and/or literature survey.

Staff

## FOR GRADUATES ONLY

PP 604 MORPHOLOGY AND TAXONOMY OF NEMATODES 3 (1-6) S

PP 605 PLANT VIROLOGY 3 (1-6) F

PP 608 HISTORY OF PHYTOPATHOLOGY 1 (1-0) F

PP 609 CURRENT PHYTOPATHOLOGICAL RESEARCH UNDER  
FIELD CONDITIONS 2 (1-3) S

PP 611 ADVANCED PLANT NEMATOLOGY 3 (2-3) S

PP 612 PLANT PATHOGENESIS 3 (2-3) F

PP 614 NEMATODE DEVELOPMENT, CYTOLOGY AND GENETICS 2 (1-3) F

PP 625 (BO 625) ADVANCED MYCOLOGY 4 (2-6) F

PP 650 COLLOQUIUM IN PLANT PATHOLOGY

3 (3-0) F

PP 690 SEMINAR IN PLANT PATHOLOGY

1 (1-0) F S

PP 699 RESEARCH IN PLANT PATHOLOGY

Credits Arranged

Advanced courses in Mycology are also available at UNC-Chapel Hill.

## POLITICS

### FOR UNDERGRADUATES

PS 200 INTRODUCTION TO POLITICS

3 (3-0) F S

An introductory survey of the body of existing knowledge about politics and political systems, including the theories and characteristics of political behavior and political institutions within and among nation-states.

Messrs. Block, Hurwitz, Kebschull, Petersen

PS 201 THE AMERICAN GOVERNMENTAL SYSTEM

3 (3-0) F S

A study of the American federal system, integrating national and state government, with emphasis on constitutional principles, major governmental organs, governmental functions, and the politics and machinery of elections. Some attention is given to other types of political systems, and comparisons are made where relevant throughout the course.

Mr. Gilbert, Staff

PS 206 LOCAL GOVERNMENTAL SYSTEMS

3 (3-0) F S

An introductory study of governmental systems in the U.S. which have a primarily local focus. In addition to the examination of traditional local forms—city, county, township, and district—attention will be given to the national, state, and regional contexts for local government. Topics will include federalism and intergovernmental relations, governmental structures, political processes and political power, urbanization and problems of social and technological change, and approaches to reform.

Messrs. Bennett, Brownlee, McClain, Wentworth, Williams

PS 222 INTRODUCTION TO GLOBAL POLITICS

3 (3-0) F S

This introduction to politics in the global arena examines roles and behaviors of nation-states and of non-state actors such as individual decision-makers, interest groups, national minorities, revolutionary groups, international organizations alliances, and multinational businesses. Major concerns include causes of international conflict, ways of resolving them, and evaluation of theories of peace and international cooperation. Some current problem areas will be analyzed, and consideration given to some alternative futures of our global system.

Mr. Soroos

PS 301 MODERN POLITICAL SYSTEMS: EUROPE

3 (3-0) F

A comparative analysis of the structure and processes of politics in the United Kingdom, France and Germany.

Mr. Kebschull

PS 302 MODERN POLITICAL SYSTEMS: ASIA

3 (3-0) S

A comparative analysis of the structure and processes of politics in Japan and Communist and Nationalist China.

Mr. Petersen

PS 303 SOUTHEAST ASIA: POLITICS AND POLITICAL CHANGE

3 (3-0) F

A survey of the political systems and the processes of political change in the ten states of Southeast Asia from Burma on the west to the Philippines on the east.

While some attention will be given to individual case studies of political systems, most of the material will be presented in a comparative manner dealing with particular challenges and responses common to several systems. Mr. Tilman

**PS 312 THE LEGAL SUB-SYSTEM: LAW AND COURTS IN THE AMERICAN POLITICAL SYSTEM 3 (3-0) F S**

A course focusing on the role of courts, state and federal, in the political system, including 1) structure, court organization and legal personnel, 2) law and the need for social order, including the role of protest and civil disobedience, and 3) functions performed by courts in the political system, from dispute settling to the initiation of social change. Mrs. Rubin

**PS 321 U.S. FOREIGN POLICY 3 (3-0) F**

This course examines the determinants of American foreign policy and the economic, military, strategic and psychological factors conditioning that policy. Emphasis is placed on the formulation of policy, including the roles of the Executive, Congress and public opinion, and on problems of content and execution. Mr. Gilbert

**PS 322 INTERNATIONAL RELATIONS 3 (3-0) F**

A study of the patterns of international life, the controls upon international behavior, including the development of the United Nations and the major problems in international relations since World War II. Attention is given to the national interests and foreign policies of the states belonging to the Western and Soviet blocs, with emphasis on the positions of the United States and the Soviet Union, and to the development and impact of the newly emerging nations. Mr. Petersen

**PS 376 LATIN AMERICAN GOVERNMENT AND POLITICS 3 (3-0) S**

An analysis of Latin American governmental structures, political parties and ideologies, with emphasis on the period since 1910. Social revolution, nationalism and relations with the United States will be stressed within the Latin American political context. Mr. Stephenson

**PS 391 METHODOLOGY OF POLITICAL SCIENCE 3 (3-0) F S**  
Prerequisite: PS 200 or PS 201

This course includes an analysis of the principles and procedures of political science research. It will include (1) an introduction to the philosophy of science; (2) fundamentals of theory construction; (3) examination of sampling, measurement of political variables and research designs; and (4) an introduction to other methods of political research, such as content analysis, use of aggregate data and simulation research. Messrs. Mastro, Soroos

**PS 401 AMERICAN PARTIES AND PRESSURE GROUPS 3 (3-0) F**

An analysis of political parties and interest groups as instruments for shaping public policy and implementing democratic values. Political parties and interest groups are considered as variables in the larger American system within which they exist. Attention focuses on the nature of their organization, their membership and leadership recruitment process, and their problems in aggregating votes. Attention will also be given to such topics as political style—the relationship between major and minor parties and the differences between the major parties. Mr. Holtzman

**PS 403 BLACK AMERICANS IN AMERICAN POLITICS 3 (3-0) F S**  
Prerequisite: Six hours of social sciences

The study of the political activity of the Afro-American; the sources of and the kinds of attitudes he brings into the American political system; the contrast in

political activity engaged in by different Black groups and reasons for the differences; the impact of the Blacks' efforts on policy-making institutions such as city councils, legislatures and executive branches of government at the state and national level.

Staff

**PS 404 BLACK POLITICAL IDEOLOGY**

3 (3-0) F S

Prerequisite: Six hours of social sciences

The study of the political thought of Black and non-Black political thinkers on the problems, struggle and movement of the Afro-Americans. Black political ideology will be related to the Afro-American movement for social change and it will be placed into the mainstream of traditional and modern political philosophy.

Staff

**PS 405 NATIONAL SECURITY POLICY**

3 (3-0) S

Prerequisite: PS 321

An investigation into (1) the making of security policy, including the role of the Executive, Congress, and non-governmental actors; (2) the evolution of changing assumptions, strategies, and goals; and (3) the nature of U.S. security requirements, U.S. military commitments abroad, and the "costs" of strategies based on arms superiority, arms control and disarmament.

Mr. Gilbert

**PS 406 POLITICS AND POLICIES OF AMERICAN STATE GOVERNMENTS**

3 (3-0) F S

The course is a comparative study of the politics and policies of the 50 states. The focus is on cultural, socio-economic and political variations and state response to intergovernmental domestic programs. Attention is given to the analysis of state efforts in taxation, education, health, welfare, transportation and regulatory policies, the implementation and administration of national programs in the state and the state's role in urban affairs.

Mr. Williams

**PS 421 SOVIET AND SOVIET BLOC FOREIGN POLICY**

3 (3-0) F S

Prerequisite: Junior standing

This course examines the elements of continuity and change in Soviet foreign policy from 1917 to the present and the post World War II policies of the Eastern European states. Foreign policy decisions are examined in light of the national interests of the Soviet Union and the Eastern European states. Special attention is given to the emergence of polycentrism, the Sino-Soviet split, and Soviet bloc relations with the West.

Mr. Mastro

**PS 431 INTERNATIONAL ORGANIZATION**

3 (3-0) S

A study of the evolving machinery and techniques of international organization with particular emphasis on the establishment, operation and development of the United Nations.

Mr. Petersen

**PS 461 PUBLIC OPINION IN DEMOCRACIES**

3 (3-0) F S

Prerequisite: Three hours of politics

The course is designed to develop a knowledge of the nature of public opinion and its functions in a democratic system of government. It focuses primarily on public opinion in the United States but also makes comparisons with other nations. The areas of emphasis are: theories concerning opinion formation and functions, public opinion research methodology, public opinion and policy development, and empirical studies on public opinion.

Mr. Bennett, Mrs. Brogden

**PS 471 LATIN AMERICA IN WORLD AFFAIRS**

3 (3-0) S

Prerequisite: PS 376 or consent of instructor

This course examines the role of the Latin American states in affairs as individual states and as a region acting through international organizations. Attention is given to the historical, political, economic, social and geographic forces conditioning

the foreign policies of these countries. Emphasis is placed on the relations of the Latin American countries with the United States. Mr. Stephenson

PS 472 SOVIET POLITICS

3 (3-0) F S

This course focuses on the contemporary Soviet political system, its structure, functions and processes, with brief consideration of the historical and ideological base of Soviet politics. As a course in comparative politics, the analysis will proceed within a framework designed to elucidate the similarities and differences of the Soviet system with other political systems. In addition, the Soviet system will be tested against a theoretical model of totalitarian dictatorships.

Mr. Mastro

PS 473 POLITICAL SYSTEMS OF NEW STATES

3 (3-0) F

This course explores the general characteristics of the political systems of the new states in Asia and Africa. Following a brief survey of the pattern and nature of colonialism, the independence movements, and the contemporary social and economic conditions of the new states, the course focuses on political ideologies, elites, and organizations and processes. Particular attention is given to the role of intellectuals and the military. The course concludes with an examination of major political, social and economic problems.

Mr. Kebschull

PS 492 SEMINAR IN POLITICS

3 (3-0)

Prerequisite: PS 391

Emphasizing intensive independent work on selected topics, this seminar develops the student's skills in the methodology of the discipline and stresses familiarity with the literature and other resources of political science.

PS 493 SEMINAR ON THEORIES OF POLITICAL VIOLENCE  
AND NONVIOLENCE

3 (3-0) S Sum.

Prerequisite: Junior standing

This course will focus upon the use of violence and nonviolence as methods for resolving conflict in a variety of national and international political arenas. The principal questions that will be considered include: What types of individuals, groups, or governments are likely to employ violent or nonviolent political behaviors? What motivations do political actors have for using these strategies? In what types of political, economic, and social situations is violence likely to occur? What are the outcomes of violent and nonviolent strategies of political conflict resolution?

Mr. Soroos

PS 494, 495 (EC 494, SOC 494, EC 495, SOC 495) URBAN SEMINAR

3 (3-0) F S

Prerequisite: Junior standing

A study of urban and urban-related problems through theories from the disciplines of politics, sociology, and economics, and their application to an existing environment. Intermixed with formal study will be field research in various local communities. In addition, students will be involved with both public and private agencies and with local leaders in ongoing programs in Raleigh and adjacent communities.

Mr. Brownlee

PS 496 GOVERNMENTAL INTERNSHIP AND SEMINAR

3-6 S Sum.

Prerequisite: Junior standing; approval of the committee of selection

Governmental internship involving formal seminars; lecture-discussions by political scientists, legislators, executives, judges, representatives of special interests and news media; four to six hours a day working on assignment to and under supervision of legislators or executives; formal report at completion of an internship covering the various aspects of the program.

Staff

**PS 498 SPECIAL TOPICS IN POLITICS****3-6 F S****Prerequisite:** Six hours of politics

The student will make a detailed investigation of a special topic in politics. The topic and mode of study will be determined by the student and a member of the department's faculty.

**FOR GRADUATES AND ADVANCED UNDERGRADUATES****PS 500 POLITICAL THOUGHT: PLATO TO THE REFORMATION****3 (3-0) F****Prerequisite:** Consent of instructor

The emergence and development of the theories underlying or explaining the political aspects of behavior, approached through the study of the writings of the principal political philosophers from the days of the Greek city-state to the Reformation.

**Mr. Marshall****PS 501 MODERN POLITICAL THEORY****3 (3-0) S****Prerequisite:** Consent of instructor

A study of the state and its relationship to individuals and groups, approached through reading of selected passages from the works of outstanding philosophers from the 16th century to the present.

**Mr. Marshall****PS 502 (ED 502) PUBLIC ADMINISTRATION****3 (3-0) F S****Prerequisite:** PS 200 or consent of instructor

A study of the factors which contribute to goal displacement in public agencies and the institutions, concepts and techniques which may be used in such agencies to reduce the effects of these factors.

**Messrs. Block, McClain, Ellis****PS 503 COMPARATIVE ADMINISTRATION****3 (3-0) F S****Prerequisite:** PS 502 or PS 473 or consent of instructor

Concentration will be on administrative systems of developing nations with limited attention to developed systems. The major emphasis will be on administrative aspects of governmental change and modernization in developing nations; colonial influence on administration; problems of establishing new nations and adapting to change in established states; bureaucratic development and behavior; theories of development administration.

**Mr. Ellis****PS 505 CONTEMPORARY POLITICAL THEORY****3 (3-0) S****Prerequisite:** Consent of instructor

The course will focus upon major topics in contemporary political theory, including the relationship between political science theory and political philosophy; the foundations, conditions, and prospects of democratic forms of government; bureaucratization and democratic values; theories of mass society; violence and revolution as possible instruments of democratic change; human nature and politics; and dilemmas of modern citizenship. Attention will be given to the actual and potential contributions of empirical studies to the analysis of the various topics. The range of writers studied will extend from social scientists, such as Robert Dahl and Seymour Lipset, to political philosophers, such as Leo Strauss, Herbert Marcuse, and Albert Camus.

**Mr. Marshall****PS 506 PUBLIC PERSONNEL ADMINISTRATION****3 (3-0) Sum.****Prerequisite:** PS 502 or consent of instructor

A study in depth of the institutions and the sequence of processes in public personnel administration. It examines existing practices but is primarily concerned with emerging theories and trends.

**Mr. Ellis****PS 507 COLLECTIVE NEGOTIATIONS IN THE PUBLIC SERVICE****3 (3-0) Sum.****Prerequisite:** PS 201 or consent of instructor

This course includes intensive consideration of the background of collective negotiations movement; analysis of key policy issues, such as bargaining rights and use of strike weapons; framework for collective negotiations; scope and conduct of negotiations; impasse resolution; grievance procedure.  
Mr. Ellis

PS 509 SCOPE AND METHOD OF POLITICS  
Prerequisite: PS 200 or consent of instructor

3 (3-0) F S Sum.

This course reviews contemporary theories, concepts and methods fundamental to the study of politics. It emphasizes current empirical research and the collateral involvement in research activities aimed at the development of basic skills in this area.  
Mr. Williams

PS 510 (EC 510) PUBLIC FINANCE  
Prerequisite: EC 205

3 (3-0) F

A survey of the theories and practices of governmental taxing, spending, and borrowing, including intergovernmental relationships and administrative practices and problems.  
Mr. McClain

PS 511 THE BUDGETARY PROCESS  
Prerequisite: Consent of instructor and at least nine hours in the social sciences, including a course in American government

3 (3-0) S Sum.

A study of the generalized budgetary process used at all levels of government in the United States. Understanding of the process is based upon comprehension of the institutions involved, the roles of politicians and professionals, and the objectives of budgetary systems. The course will also focus upon budgetary reforms and the expanding Planning-Programming-Budgeting System as a management tool.  
Mr. McClain

PS 512 AMERICAN CONSTITUTIONAL THEORY  
Prerequisite: PS 200 or an acceptable substitute

3 (3-0) F

Basic constitutional doctrines, including fundamental law, judicial review, individual rights and political privileges, and national and state power. Special attention is given to the application of these doctrines to the regulation of business, agriculture and labor and to the rights safeguarded by the First, Fifth and Fourteenth Amendments to the Constitution.  
Mr. Cahill

PS 515 AMERICAN POLITICAL THOUGHT  
Prerequisite: Senior or graduate standing

3 (3-0) F S Sum.

The course will examine and evaluate major American writings on the nature and purpose of politics. Readings will be grouped under the following topics: (1) Various interpretations of the American Constitution and the principles embodied therein; (2) Writings on civil and natural rights; (3) The character of American liberalism; (4) Black American political thought and (5) The contemporary crisis in liberal thought. The purpose is to develop the independent capacity to read and reflect with care on the grounds of different views about American politics.  
Mr. Marshall

PS 516 PUBLIC POLICY ANALYSIS

3 (3-0) F S

Prerequisite: Graduate standing; advanced undergraduate standing and consent of instructor

Course will focus on the theories and methodology of analyzing and explaining public policy and the substance of recent domestic policies in the human and physical resources area, including welfare, poverty, education, housing, urban renewal, transportation, recreation-conservation, and agriculture.  
Mr. Williams

PS 517 (SOC 517) THE POLICE BUREAUCRACY IN A DEMOCRATIC  
SOCIETY

3 (3-0) F S

Prerequisite: Senior or graduate standing

This is a political science seminar which focuses on the proposition that police departments are bureaucratic organizations which can be studied as such. Emphasis is placed on understanding the process by which police policy is made. Internal and external, psychological and structural variables are identified in tracing decisions on specific issues. Thus, attitudes of policemen, the nature of their work, and the resources and power of various constituencies are factors seen as determining police behavior.

Mr. Wentworth

PS 520 URBAN POLITICS

3 (3-0) F S

Prerequisite: PS 206

A comparative study of political conditions in cities and localities. Topics will include the formal structures and rules of city and metropolitan governments, and the relationships to the informal norms and distribution of power; patterns of local decision-making; elite recruitment and citizen participation; variations of local autonomy and the scope of local politics; and approaches to urban policy issues.

Mr. Brownlee

PS 521 PROBLEMS IN URBAN AND METROPOLITAN AREA GOVERNMENT

3 (3-0) S

Prerequisite: PS 206 or consent of instructor

This course examines theory and research on problems affecting governments in metropolitan areas. Principal attention is given to those problems which affect (or result from) governmental structure, institutions, and politics and to the alternative approaches to their solution.

Staff

PS 522 SEMINAR ON WAR AND PEACE IN THE INTERNATIONAL SYSTEM

3 (3-0) F

Prerequisite: Senior standing

This seminar will focus upon war and peace in the international system; in particular, the circumstances under which violent international conflict is likely and the factors that enhance the probability that the conflicts will be resolved by peaceful means. Consideration will not only be given to the wars and problems of the past but also to alternative future worlds in which war or peace might be prevalent. The course will focus on empirical theory and research including the work of peace theorists and future researchers.

Mr. Soroos

PS 531 THE LEGISLATIVE PROCESS

3 (3-0) S

Prerequisite: PS 206 or consent of instructor

A study of the formulation of public policy from the institutional and behavioral viewpoints. Important current legislative problems at the congressional and state legislative levels will be selected and will serve as a basis for analyzing the legislative process.

Mr. Holtzman

PS 532 THE CHIEF EXECUTIVE

3 (3-0) F Sum.

Prerequisite: PS 200 or PS 201

This course will focus upon three major concepts of the office of the chief executive, as developed under several incumbents. First are the institutions which surround the office and which facilitate the expansion of its power and operations. Next are the various roles which are played with more or less success by different chief executives. Last are the processes of leadership by which the chief executive can attempt to direct the machinery of government to achieve predetermined objectives.

Messrs. Block, Holtzman

PS 533 THE JUDICIAL PROCESS

3 (3-0) S

Prerequisite: PS 200 or PS 201

A comparative examination of the judicial process in the United States, England

and France. After a brief examination of the nature and main categories of law, the course will cover such matters as staffing of courts, the participants in litigation, the American judicial system, special consideration of the role of the U. S. Supreme Court, court systems in the countries listed above and finally, a thorough examination of judicial review in action. Administrative tribunals will receive some attention.

Mr. Cahill

**PS 542 GOVERNMENTAL PLANNING**

3 (3-0) F Sum.

Prerequisite: PS 502

A study of the planning function at all levels of government in the United States, with particular attention to the problems posed for planning by the rapid growth of metropolitan areas.

Mr. McClain

**PS 572 SEMINAR IN COMPARATIVE POLITICS**

3 (3-0) F S

Prerequisite: One course in comparative politics

This seminar will open with a survey of the problems and methods of comparative political analysis, after which students will be assigned a specific, limited subject to be examined within the framework of a systematic, analytical scheme appropriate to the topic. Specific topics will be drawn from the subjects of political ideologies, political groups, political elites, and decision-making institutions and processes.

Mr. Kebschull

**PS 573 PROBLEMS OF NATIONAL INTEGRATION AND INSTITUTION  
BUILDING IN BLACK AFRICA**

3 (3-0) S

Prerequisite: Comparative government course or consent of instructor

A central problem in the political development of African nations is the building of institutions capable of creating and managing change in the face of cultural pluralism. This course will look at theories of cultural pluralism, the background and consequences of cultural pluralism in Africa, and the attempts by various political actors and institutions (e.g., "charismatic" leaders, political parties, armies, governments) to cope with the fact of cultural pluralism.

Mr. Hurwitz

**PS 574 POLITICAL SYSTEMS AND CONSTRAINTS ON DEVELOPMENT  
IN LATIN AMERICA**

3 (3-0) S

Prerequisite: Senior or graduate standing

The course focuses on the adequacy of Latin America's contemporary political systems for meeting the challenges of economic development. Several different approaches to developmental problems will be studied, as well as political factors which have retarded their implementation. The political systems of Latin America will be examined, along with the value systems and power capabilities of important groups. The leftist critique of the established political systems and its relationship to contemporary guerrilla movements concludes the course.

Mr. Stephenson

**PS 575 POLITICAL DEVELOPMENT**

3 (3-0) F

Prerequisite: Nine hours of political science

This course examines the concept, theories, characteristics and problems of political development. Within a broad historical framework, particular subjects are analyzed in relationship to political development. Data derived from comparative cultural and political studies are employed in an attempt to discover patterns of change related to political development.

Messrs. Kebschull and Hurwitz

**PS 578 COMPARATIVE COMMUNIST SYSTEMS**

3 (3-0) F

Prerequisite: Comparative government course or consent of instructor

A study of the international Communist movement and the evolution of the international sub-system of Communist states. Focuses on the Soviet and Chinese systems as alternative models for development in Communist and non-Communist

states. Additional emphasis is placed on the institutional, political and ideological similarities and differences within the Communist world and major Communist parties outside the Communist state system. Mr. Mastro

#### PS 590 TOPICS IN POLITICAL THEORY

3 (3-0) F S Sum.

Prerequisite: Senior or graduate standing

Maximum 6

A close examination of particular topics or theorists that are not included in the basic courses in political theory. Course content changes in different years, and, with permission of instructor, the course may be repeated for credit. Examples of course topics are: "Foundations of Modern Radicalism," "Twentieth Century Political Philosophy," "Political Philosophy and Political Science," "Political Philosophy and the Problem of Law," and "Origins of Political Science."

Mr. Marshall

### FOR GRADUATES ONLY

PS 601	SEMINAR IN PARTY AND GROUP POLITICS	3 (3-0) S
PS 602	SEMINAR IN LEGISLATIVE PROBLEMS	3 (3-0) S
PS 603	SEMINAR IN ADMINISTRATIVE PROBLEMS	2-4 S Sum.
PS 604	SEMINAR IN JUDICIAL PROBLEMS	3 (3-0) F
PS 605	SEMINAR IN ORGANIZATION THEORY	3 (3-0) F S
PS 606	SEMINAR IN POLICY AND ADMINISTRATION	3 (3-0) F
PS 621	SEMINAR IN INTERNATIONAL POLITICS	3 (3-0)
PS 696	SEMINAR IN POLITICS	2-4 F
PS 699	RESEARCH IN POLITICS	Credits Arranged F S

### POULTRY SCIENCE

#### FOR UNDERGRADUATES

PO 201	POULTRY SCIENCE AND PRODUCTION	4 (3-3) F S
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Prerequisite: BS 100

Introductory course in the area of poultry science and production that includes the fundamental principles of broiler, turkey and egg production. Areas covered will include poultry physiology, breeding incubation, housing, nutrition, disease control, management and marketing that collectively form the nucleus of today's poultry industry. Mr. Parkhurst

PO 301	EVALUATION OF LIVE POULTRY	2 (1-3) S
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Prerequisite: PO 201

Experience in evaluating live poultry for production and breeder stock potential. Emphasis will be placed on the techniques and criteria used in selecting live poultry for use in commercial production units. Mr. Parkhurst

PO 351	GRADING AND EVALUATION OF POULTRY PRODUCTS	2 (1-3) F
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Prerequisite: PO 301

Experience in grading and evaluating poultry products, such as dressed broilers, fowl, turkeys, shell eggs and broken-out eggs. Mr. Parkhurst

**PO 401 POULTRY DISEASES**

4 (3-2) S

The major infectious, noninfectious and parasitic diseases of poultry are studied with respect to economic importance, etiology, susceptibility, dissemination, symptoms and lesions. Emphasis is placed upon practices necessary for the prevention, control and treatment of each disease.

Mr. Colwell

**PO 402 COMMERCIAL POULTRY ENTERPRISES**

4 (3-2) S

Required of technology and business majors in poultry science, etc.

Principles of incubation of chicken and turkey eggs; hatchery management; organization and development of plants for the operation and maintenance of a commercial poultry farm for meat and egg production; study of the types of buildings, equipment and methods of management currently employed by successful poultrymen in North Carolina. Problem.

Staff

**PO 404 (FS 404) POULTRY PRODUCTS**

3 (2-3) F

(See food science, page 334.)

**PO 405 AVIAN PHYSIOLOGY**

4 (3-3) S

Prerequisites: CH 220

A study of the principles of avian physiology integrating the physiological processes and their associated anatomical structures that insure the homeostatic state in birds.

Mr. Thaxton

**PO 415 (ANS 415, NTR 415) COMPARATIVE NUTRITION**

3 (3-0) F

Prerequisites: CH 220 or CH 221

Fundamentals of animal nutrition, including the classification of nutrients, their requirement and general metabolism by different species for health, maintenance, growth and other productive functions.

Messrs. Donaldson, Ramsey

**PO 490 POULTRY SEMINAR**

1 (1-0) F S

Required of seniors in poultry science.

Current topics and problems relating to poultry science and to poultry industry are assigned for oral report and discussion.

Staff

**PO 495 SPECIAL PROBLEMS IN POULTRY SCIENCE**

1-6 F S

Prerequisite: Junior standing and consent of instructor

Individualized study of problems in poultry science in the student's area of interest and not covered in scheduled courses. Emphasis will be placed upon student research problems developed with faculty approval.

Staff

**FOR GRADUATES AND ADVANCED UNDERGRADUATES****PO 520 (GN 520) POULTRY BREEDING**

3 (2-2) F

Prerequisite: GN 411

Application of genetic principles to poultry breeding considering physical traits and physiological characteristics—feather patterns, egg production, hatchability, growth, body conformation and utility.

Mr. Blow

**PO 524 (ZO 524) COMPARATIVE ENDOCRINOLOGY**

4 (3-3) S

Prerequisite: ZO 421 or ZO 414

Study of the endocrine system with respect to its physiological importance to metabolism, growth and reproduction.

Mr. Prince

**FOR GRADUATES ONLY**

*NOTE: Graduate courses may not be offered if registration for the course is too low or if faculty or facilities become unavailable.*

## PRODUCT DESIGN

### PD 321, 322 COLLOQUIUM I, II

1 (1-0) F S

A survey of the historically evolving passive and active interaction of the arts, technological, sociological and psychological forces. Lectures by professional authorities (faculty and guests) and discussions under their guidance. Required selected reading and field experience.  
Staff

### PD 400 INTERMEDIATE PRODUCT DESIGN (SERIES)

4 (6-3) F S

Prerequisite: DN 202 or equivalent or consent of department

This group of courses shall be concerned with various social/economic age groups, various forms and rates of production, and various natural and synthetic materials.  
Messrs. Cooke, Masterton

### PD 411, 412 APPLIED PHYSICAL PRINCIPLES

3 (2-2) F S

Prerequisite: Intermediate design standing

Various experiments applying physical principles to product design and development.  
Staff

### PD 421, 422 COLLOQUIUM III, IV

1 (1-0) F S

Continuation of Colloquium I, II (PD 321, PD 322), treating various phases of the subject in depth. Special emphasis on communication systems and media of communication. Faculty, guest lecturers, discussions and "field experience". Required selected reading.  
Staff

### PD 431, 432 OFFICE AND INDUSTRIAL PRACTICE I, II

1 (1-0) F S

Study of the ethics, organization and procedures of professional product design practice, patent law.  
Staff

### PD 440 INTERMEDIATE VISUAL DESIGN (SERIES)

4 (6-3) F S

Prerequisite: DN 202 or equivalent or consent of department

Intermediate investigations of the visual environment through the agency of various materials and processes leading to professional competence in visual design.  
Messrs. Doty, Hedge

### PD 490 INTERMEDIATE SPECIAL PROJECTS (SERIES)

2 (1-3) F S

Special projects guided by various faculty specialists involved in areas supplementary to product design and visual design option.  
Staff

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

### PD 501, 502 PRODUCT DESIGN V, VI

6 (3-12) F S

Prerequisite: PD 400 or graduate standing

PD 501—Unlimited production systems designed with object(s) possibilities produced additively of new synthetic materials utilizing new molecular joining for national class and age groups. PD 502—Unlimited production systems designed object(s) possibilities produced additively of new synthetic materials utilizing new molecular joining for international class and age groups. (Individually selected problems with interdisciplinary team organizations.) NOTE: It shall be assumed that the program is cumulative and that these statements are problem parameters, exclusive of communication requirements.  
Mr. Foote

**PD 511, 512 MATERIALS AND PROCESSES V, VI****2 (1-3) F S****Prerequisite:** Graduate standing

Advanced studies in mass production processes and their influence on design. Emphasis placed on material search and process selection in relation to cost, function, human factors, form, finishes and joining methods, as indicated by the current design projects in which the students are involved.

**Mr. Foote****PD 532 OFFICE AND INDUSTRIAL PRACTICE****1 (1-0) F S****Prerequisite:** PD 432 or graduate standing

Advanced studies and procedures of professional product design practice, product and industrial planning, and patent law.

**Staff****PD 541, 542 ADVANCED VISUAL DESIGN I, II****6 (3-9) F S**

**Prerequisites:** ARC 400, LAR 400, PD 400, PD 440; waiver of prerequisites is at the discretion of the instructor.

Application of previous studies in design and visual communications to a wide variety of visual problems presented by our physical environment.

**Mr. Hedge****PD 590, 591 SPECIAL PROJECTS****3 (1-6) F S**

Special projects of an interdisciplinary nature, guided by various faculty specialists involved in areas supplementary to product design. Emphasis placed on latest technological development of new materials. Also emphasis on concept of new useful design for the mass market. The production aspects of products such as materials, processes, functions, human factors, form, sales appeal, finishing and assembly methods and packaging will be stressed in special projects designs.

**Staff****FOR GRADUATES ONLY****PD 601, 602 ADVANCED PRODUCT DESIGN VII, VIII****6 (0-18) F S****PD 631, 632 ADVANCED CONCEPTS IN PRODUCT ENGINEERING****3 (3-0) F S****PSYCHOLOGY****FOR UNDERGRADUATES****PSY 200 INTRODUCTION TO PSYCHOLOGY****3 (3-0) F S**

A study of the general characteristics of human behavior, including motivation, learning, development, thinking, perception, sensation, and measurement. The objectives are: development of the ability to communicate in oral and written form accurately and scientifically about behavior; development of an understanding of and a capacity to use scientific ideas and processes as they apply to behavior; an understanding of the behavior of organisms.

**Staff****PSY 210 PSYCHOLOGICAL ANALYSIS APPLIED TO CURRENT PROBLEMS****3 (3-0) F S****Prerequisite:** PSY 200

This course will seek to develop skill in the analysis and understanding of certain current problems through the use of psychological knowledge and techniques. The problems to be studied will be selected each time the course is offered, from such topics as: the effects of automation, the racial crisis; international conflict, human development, population control, etc. One of the chief criteria for the selection of topics will be the existence of substantial scientific psychological literature in the area.

**Mr. Miller**

- PSY 300 PERCEPTION** 3 (2-2) S  
Prerequisites: PSY 200, sophomore standing; introductory PY or CH recommended  
An introduction to the anatomy and physiology of the major sensory systems, their relation to central and motor structures, and the elementary facts of sensory psychophysics. An extensive survey of the chief determiners of perception, including stimulus properties, extraneous environmental factors, and organismic variables such as learning and motivation. Laboratory studies of classical problems in perception.  
Staff
- PSY 302 PSYCHOLOGY OF PERSONALITY AND ADJUSTMENT** 3 (3-0) F  
Prerequisite: PSY 200  
A study of the factors involved in the development of the normal personality, emphasizing the principal factors controlling human behavior and their relationship to adjustment mechanisms.  
Messrs. Corter, Norton
- PSY 304 EDUCATIONAL PSYCHOLOGY** 3 (3-0) F S  
Prerequisites: PSY 200  
A study of learning, instruction, motivation and evaluation in the context of educational practice.  
Messrs. Gardner, Johnson, Miller, Mrs. Rawls
- PSY 310 LEARNING AND MOTIVATION** 3 (2-2) F  
Prerequisites: PSY 200, PSY 300 recommended  
The objectives of this course are (1) to acquaint students with the structure of the areas of learning and motivation and with the major theories and empirical findings in these areas; (2) to develop skill in deriving and testing implications of theories and in manipulating concepts.  
Messrs. Cole, Newman
- PSY 320 COGNITIVE PROCESSES** 3 (2-2) S  
Prerequisites: PSY 200, PSY 310  
This is a course in complex cognitive processes such as: thinking, reasoning, problem solving, creativity and originality, intelligence, social interaction, verbal behavior and decision processes. It will emphasize theoretical approaches, research findings, and will aim at developing skills in deriving and testing hypotheses in these areas.  
Mr. Newman
- PSY 337 INDUSTRIAL PSYCHOLOGY I** 3 (3-0) F S  
Prerequisite: PSY 200  
The application of psychological principles to the problems of industry, business, and other organizations and institutions.  
Staff
- PSY 338 (IE 338) HUMAN FACTORS IN EQUIPMENT DESIGN** 3 (2-2) F S  
Prerequisites: PSY 337 or IE 332  
An introduction to methodology in human factors research, equipment design, biomechanics, and accident study. Man's sensory, motor, and decision-making abilities are related to problems of systems design, operator efficiency, and safety as these involve displays, controls, workplace layout, and environmental stressors.  
Mr. Pearson
- PSY 350 INTERVIEWING AND BEHAVIOR OBSERVATION SKILLS** 4 (2-6) F  
Corequisite courses: PSY 351, PSY 352, SP 231  
Students will be instructed and receive extensive practice in interviewing and the development of skill in behavior observation. Such skills will be developed with children of all age levels and with adults, particularly those coming from disadvantaged and varied cultural backgrounds.  
Messrs. Gardner, Miller
- PSY 351 INSTRUCTIONAL SKILLS** 4 (2-6) F  
Corequisite courses: PSY 350, PSY 352, SP 231

Development of skills in the psychology of instructing, tutoring, instructional programming, and instructional communication with emphasis on disadvantaged learners; problems of measurement, evaluation, and test construction.

Messrs. Gardner, Miller

**PSY 352 ORGANIZATIONAL SKILLS**

4 (2-6) F

Corequisite courses: PSY 350, PSY 351, SP 231

The following topics will be covered: (1) Current theories of organizational structure and process applicable to human serving organizations, (2) problems associated with change and intervention in human serving organizations, (3) recognition and determination of organizational goals, and (4) organizational gaming.

Messrs. Gardner, Miller

**FOR ADVANCED UNDERGRADUATES**

**PSY 411 SOCIAL PSYCHOLOGY**

3 (3-0) S

Prerequisite: PSY 200

The individual in relation to social factors. Socialization, personality development, communication, social conflict and social change.

Mr. Luginbuhl

**PSY 475 CHILD PSYCHOLOGY**

3 (3-0) S

Prerequisite: PSY 200 or PSY 304

Emphasis will be placed upon the intellectual, social, emotional and personality development of the child. Physical growth will be emphasized as necessary to an understanding of the psychological development of the pupil.

Mr. Gardner, Mrs. Rawls

**PSY 476 ADOLESCENT PSYCHOLOGY**

2 (2-0) F S

Prerequisite: PSY 200 or PSY 304

A study of adolescent behaviors considered to be important to their education. Emotional, social, intellectual and personality development are emphasized.

Mr. Gardner, Mrs. Rawls

**PSY 491, 492 SEMINARS IN PSYCHOLOGY**

3 (0-3) F S

Prerequisite: Senior standing, consent of department

This course is designed to provide the undergraduate psychology major with skill in designing and conducting independent research studies; knowledge of sources and skill in locating information pertaining to behavior; knowledge of major trends in selected areas of study; knowledge of the research techniques available to the psychologist, knowledge of the organization of psychology as a profession; and an understanding of the code of ethics for psychologists.

Staff

**PSY 493 SPECIAL TOPICS IN PSYCHOLOGY**

1-6 S

Prerequisite: Consent of instructor

An individual study course. Any undergraduate student may suggest an activity (review of literature on a topic, designing and conducting an experiment, or survey, etc.) to a professor. After discussing the activity, if both student and professor agree that it is worthwhile and that the student is competent to undertake it, and if the professor is willing to direct the activity, then the student will enroll in PSY 493 the following semester.

Staff

**PSY 495 HUMAN RESOURCE DEVELOPMENT PRACTICUM**

8 (0-8) S

Prerequisites: Junior standing, psychology HRD option, PSY 350, 351, 352, SP 231

This course is designed to provide the student with an opportunity to acquire field experience in the use of skills acquired during the skill semester. The student will spend at least a full semester working in a selected off-campus center. In addition to practicing his skills, the student will be able to experience real-world

problems in context, and thus can arrange his later course work around subjects applicable to the solution of those problems. Messrs. Gardner, Miller

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

### PSY 500 PERCEPTION

3 (2-2) S

Prerequisite: Graduate standing

The first half of the course will be a summary and analysis of the major classes of variables affecting sensation and perception. The data will be examined in the context of the development of theories of perception with emphasis on the general problem of scientific method and theory construction as the specific content of perceptual theory. The second half of the course will summarize and analyze the major modes of thinking and the variables affecting the thinking process. Special emphasis will be placed on the relationship between perception and thinking, and a number of the theories of thinking will be evaluated. Mr. Newman

### PSY 502 PHYSIOLOGICAL PSYCHOLOGY

3 (3-0) F

Prerequisites: Twelve hours of psychology, including PSY 200, PSY 300, PSY 310

A survey of the neuroanatomical and neurophysiological mechanisms of behavior with emphasis upon mammalian neuroanatomy, neural conduction, synaptic transmission and reflex mechanisms. This course is designed to form a basis for advanced study of the neurophysiological requisites of more complex behavioral processes. Mr. LeVere

### PSY 503 (ZO 503) COMPARATIVE PSYCHOLOGY

3 (3-0) S

Prerequisites: PSY 310 and BS 100 or consent of instructor

Covers the history of the study of comparative behavior of organisms; methodological and theoretical problems peculiar to comparative psychology, with emphasis on the ontogeny and evolution of behavior in vertebrate animals. Mr. Gottlieb

### PSY 504 ADVANCED EDUCATIONAL PSYCHOLOGY

3 (3-0) F S

Prerequisites: Six hours in psychology

A critical appraisal of potential contributions of psychology to the analysis and improvement of instruction. This course provides a laboratory in which the student practices various applications of psychology to instruction.

Messrs. Gardner, Johnson, Miller, Mrs. Rawls

### PSY 505 HISTORY AND SYSTEMS OF PSYCHOLOGY

3 (3-0) S

Prerequisites: PSY 200, 300, 320 or permission of instructor, or graduate status

The aim of this course is to acquaint students with the history of psychology and psychological systems and to give students some practice in taking different approaches to a particular problem area. Staff

### PSY 510 LEARNING AND MOTIVATION

3 (3-0) F

Prerequisite: Graduate standing

A systematic analysis of some of the major classes of variables determining behavioral change. Learning variables are analyzed within their primary experimental setting, and emphasis is upon the diversity of the functions governing behavior change rather than upon the development of some comprehensive theory. Both learning and motivational variables are examined as they contribute to changes in performance within the experimental setting.

Messrs. Cole, Newman, Pearson

### PSY 511 ADVANCED SOCIAL PSYCHOLOGY

3 (0-3) F

Prerequisites: Graduate status or consent of instructor

A survey of theory and research in social psychology through reading and

discussion of primary source materials. In addition, the course will deal with issues of methodology, ethical questions in social psychological research, and application of research findings to the world at large. Mr. Luginbuhl

PSY 514 LOGICAL FOUNDATIONS OF BEHAVIORAL ANALYSIS 3 (3-0) F  
Prerequisite: Graduate standing in psychology

An analysis of fundamental considerations involved in the formulation and verification of theories of behavior. Such topics as operationalism, formalism, reductionism, logical analysis and the nature of truth in empirical sciences will be introduced and related to research in various areas of psychological interest. The objectives are to provide insight into the nature of scientific research, to foster the ability to derive empirical hypotheses, to develop facility in designing experimental tests of hypotheses, and to promote effective writing and speaking about psychological theory and experimentation. Staff

PSY 520 COGNITIVE PROCESSES 3 (2-2) F  
Prerequisite: Graduate standing

This course will emphasize the results from research on a number of complex processes (e.g. remembering, concept learning, acquisition and use of language) and the theories that have been proposed to explain these results. Mr. Newman

PSY 530 ABNORMAL PSYCHOLOGY 3 (3-0) S  
Prerequisites: PSY 200, PSY 302

A study of the causes, symptomatic behavior and treatment of the major personality disturbances. Emphasis will be placed on theory, experimental psychopathology and preventive measures. Mr. Duke

PSY 531 (ED 531) MENTAL DEFICIENCY 3 (3-0) S Sum.  
(See education, page 307.)

PSY 532 PSYCHOLOGICAL ASPECTS OF EXCEPTIONALITY 3 (3-0) S  
Prerequisite: Consent of instructor

This course is designed to give consideration to effects of severe deviancy (sensory, physical, mental, etc.) arising from any causes at any stage of life; the personal and social ramifications of these; and possible courses of intervention; as well as utilization of psychological theory and clinical information in interpreting probable implications. Research findings related to sensory deprivation, research needs and possible research projects will be discussed. Mrs. Rawls

PSY 535 TESTS AND MEASUREMENTS 3 (3-0) F S  
Prerequisite: Six hours in psychology

A study of the principles of psychological testing including norms and units of measurement, elementary statistical concepts, reliability, and validity. In addition, some attention is devoted to the major types of available tests such as general intellectual development, tests of separate abilities, achievement tests, measures of personality, and interest inventories. Mr. Westbrook

PSY 540 (IE 540) HUMAN FACTORS IN SYSTEMS DESIGN 3 (3-0) S  
Prerequisites: ST 513 or ST 515; PSY 338 (IE 338) or consent of instructor

Introduction to problems of the systems development cycle, including man-machine function allocation, military specifications, display-control compatibility, the personnel subsystem concept, and maintainability design. Detailed treatment is given to man as an information processing mechanism. Mr. Pearson

PSY 565 ORGANIZATIONAL PSYCHOLOGY 3 (3-0) S  
Prerequisite: Nine hours in psychology

A study of the application of behavioral sciences, particularly psychology and social psychology, to organizational and management problems. Mr. Miller

**PSY 570 THEORIES OF PERSONALITY****3 (3-0) F****Prerequisite:** Graduate standing

A review of theories of personality, with emphasis on research, application in psychotherapy and measurement, and principles involved in similarities and differences among them.

**Mr. Corter****PSY 571 INDIVIDUAL INTELLIGENCE MEASUREMENT****3 (3-0) S****Prerequisite:** PSY 570

A practicum in individual intelligence testing with emphasis on the Wechsler-Bellevue, Stanford-Binet, report writing and case studies.

**Mr. Corter****PSY 575 BEHAVIOR MODIFICATION****3 (2-2)**

**Prerequisites:** Graduate standing; PSY 510 or equivalent; and/or permission of instructor

The course will deal with the application of Behavior Modification techniques. Balanced emphasis will be placed upon theoretical foundations, ethical considerations, acquisition of skills, and practicum experiences. Specifically, course content will consist of methods of applying laws derived from the psychology learning laboratory such as reinforcement schedules, contingency specifications and objective behavioral analyses to the solution of behavioral problems in practical situations. Enrollment limited to 12 students; priority (1) community/clinical and school psychology, (2) other psychology graduate students.

**Mr. Maleski****PSY 576 DEVELOPMENTAL PSYCHOLOGY****3 (3-0) F****Prerequisites:** Nine hours in psychology, including PSY 475 or PSY 476

A study of the development of human behavior, with attention given to theoretical issues and research in developmental psychology.

**Messrs. Gardner, Johnson, Mrs. Rawls****PSY 578 INDIVIDUAL DIFFERENCES****3 (3-0) F S****Prerequisites:** Six hours in psychology

Nature, extent and practical implications of individual differences and individual variation.

**Graduate Staff****PSY 591 AREA SEMINAR IN CLINICAL-COMMUNITY PSYCHOLOGY****1-3 F S****Prerequisite:** Consent of instructor**6 Maximum**

The following topics will be dealt with (1) the development of clinical community psychology as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationships to other areas within psychology.

**Staff****PSY 592 AREA SEMINAR IN EXPERIMENTAL PSYCHOLOGY****1-3 F S****Prerequisite:** Graduate standing in psychology**6 Maximum**

The following topics will be dealt with (1) the development of experimental psychology as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationships to other areas within psychology.

**Staff****PSY 593 AREA SEMINAR IN HUMAN FACTORS ENGINEERING****1-2 F S****Prerequisite:** Graduate standing**3 Maximum**

The following topics will be dealt with (1) the development of human factors as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationships to other areas within psychology.

**Staff****PSY 594 AREA SEMINAR IN HUMAN RESOURCES DEVELOPMENT****1-3 F S****Prerequisite:** Consent of instructor**6 Maximum**

The following topics will be dealt with (1) the development of human resources development as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationships to other areas within psychology

**Staff**

PSY 595	AREA SEMINAR IN SCHOOL PSYCHOLOGY	1-3 F S
Prerequisite: Graduate status		6 Maximum

The following topics will be dealt with (1) the development of school psychology as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationships to other areas within psychology. Staff

PSY 596	AREA SEMINAR IN SOCIAL PSYCHOLOGY	1-3 F S
		6 Maximum

The following topics will be dealt with (1) the development of social psychology as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationships to other areas within psychology. Staff

PSY 599	RESEARCH PROBLEMS IN PSYCHOLOGY	Credits Arranged F S
Prerequisite: Consent of instructor		

Research project for graduate students supervised by members of the graduate faculty. Research to be elected on basis of interest of student, and is not to be part of thesis or dissertation research. Graduate Staff

## FOR GRADUATES ONLY

PSY 602	PHYSIOLOGICAL PSYCHOLOGY	3 (3-0) S
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PSY 603	VERBAL LEARNING AND VERBAL BEHAVIOR	3 (3-0) S
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PSY 604	CLASSICAL CONDITIONING	3 (3-0) F
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PSY 605	INSTRUMENTAL LEARNING	3 (3-0) S
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PSY 607	ADVANCED INDUSTRIAL PSYCHOLOGY I	3 (3-0) S
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PSY 608	ADVANCED INDUSTRIAL PSYCHOLOGY II	3 (3-0) F
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PSY 610	THEORIES OF LEARNING	3 (3-0) F S
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PSY 611	SOCIAL PSYCHOLOGY: SMALL GROUPS RESEARCH	3 (3-0) S
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PSY 635	PSYCHOLOGICAL MEASUREMENT	3 (3-0) S
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PSY 640	(IE 640) SKILLED OPERATOR PERFORMANCE	3 (3-0) F
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PSY 672	PERSONALITY MEASUREMENT	3 (2-3) F S
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PSY 674	PSYCHOLOGICAL INTERVENTION I	3 (2-2) F
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PSY 675	PSYCHOLOGICAL INTERVENTION II	3 (2-2) S
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PSY 690	SEMINAR IN INDUSTRIAL PSYCHOLOGY	3 (3-0) F S
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PSY 691	SPECIAL TOPICS IN PSYCHOLOGY	1-3 F
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PSY 693	PSYCHOLOGICAL CLINIC PRACTICUM	Maximum 12 F S
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PSY 696	ADVANCED PROBLEMS IN PERCEPTION	3 (2-2) F
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PSY 697	(ED 697) ADVANCED SEMINAR IN RESEARCH DESIGN	3 (3-0) F S
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PSY 699	THESIS AND DISSERTATION RESEARCH	Credits Arranged F S
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# RECREATION RESOURCES ADMINISTRATION

## FOR UNDERGRADUATES

### RRA 152 INTRODUCTION TO RECREATION 3 (3-0) F S

This course is designed to provide instruction in the areas of history and foundations of recreation including objectives, economic and social aspects, definition and importance; status or organized recreation in our modern society; certain applied principles of recreation.  
Staff

### RRA 215 MAINTENANCE AND OPERATION I 3 (3-0) F S Prerequisite: RRA 152

This course deals with methods of operation of various park and recreation facilities for public use; protection and law enforcement; job planning and scheduling; preventive maintenance; and modern maintenance techniques and maintenance materials.  
Mr. Warren

### RRA 216 MAINTENANCE AND OPERATIONS II 3 (3-0) F S Prerequisite: RRA 152

This course is a continuation of RRA 215 with emphasis upon water-oriented recreation and public camping facilities; swimming pools; beaches; small lake management; marinas; day and family camping.  
Mr. Stott

### RRA 241 RECREATION RESOURCE RELATIONSHIPS 3 (3-0) F S Corequisite: FOR 472 or ZO 221

This course is an examination of the concepts and principles involved in identifying and describing natural recreation resource components significant to the management process. Major study is made of the relationships between various governmental agencies and private enterprise in providing forest recreation.  
Mr. Cordell

### RRA 353 PUBLIC CAMP ADMINISTRATION 3 (2-2) F S Prerequisite: RRA 152

This course surveys the development of organized camping and the educational, health and recreational objectives of camping. Program planning and leadership training in community, private, agency and school camping is emphasized. Laboratory will provide practice in campcraft skills.  
Mr. Warren

### RRA 354 PERSONAL AND COMMUNITY HEALTH 3 (3-0) F S Prerequisite: Junior standing

This course presents the essential present-day knowledge of personal and community health. Emphasis is placed upon health problems, disease prevention, communicable diseases and their control, public health administration, school and industrial hygiene, and various other health problems confronting the individual and community. The course presents valuable and interesting health information to college men and women in order that they might live more intelligently in terms of newer health concepts and also be better prepared to assume their responsibilities as citizens of their respective communities.  
Mr. Miller

### RRA 358 THE RECREATION PROGRAM 4 (2-4) F S Prerequisite: RRA 216

This course includes the types of recreation opportunities to be made available to individuals, groups, neighborhoods or municipalities and the methods of providing these opportunities.  
Mr. Smith

### RRA 359 RECREATION AND PARK SUPERVISION 3 (2-2) F S Prerequisite: RRA 358

Supervision is the act of directing, inspecting and critical evaluation. Particular emphasis is focused upon the roles of the public recreation supervisor, community centers, sports, special activities, maintenance and operation. Mr. Sternloff

**RRA 440 RECREATION RESOURCES INVENTORY AND PLANNING** 3 (2-2) F S  
Prerequisite: RRA 241

This course is an examination of concepts and principles which provide a basis for recreation resources quantification and allocation and factors which are involved in inventorying the physical properties and associated intangible values of the recreation resource on extensive wildlands. The resource planning function is studied as an essential component of the managerial process. Mr. Hammon

**RRA 441 RECREATION RESOURCES DEVELOPMENT** 3 (3-0) F S  
Prerequisite: RRA 241

The recreation resource manager's role in situations typical of the Federal, State and private sectors is examined. Categories of information are reviewed as to their significance in the decision-making and problem-solving process. Competent information systems are examined. Mr. Hammon

**RRA 442 WILDLAND RECREATION ENVIRONMENTS** 3 (2-3) F S  
Prerequisite: Junior standing

A study of environmental modifications and resource developments required to support recreation use. Factors affecting the selection of sites for development are related to resource planning functions. Site planning procedures provide a basis for managerial review. Natural history interpretation is an element of resource management. Concepts of natural beauty are reviewed, and approaches to the preservation of amenities through modified methods of commercial product management are explored. Mr. Warren

**RRA 451 FACILITY AND SITE PLANNING** 3 (0-6) F S  
Prerequisites: RRA 215 and RRA 216

This course includes the history of park and recreation facility development and trends in recreation facility planning. Emphasis is placed upon the planning principles involved in the design and layout of recreation areas and recreation buildings. Field trips will enable the student to see the various types of recreation facilities. Mr. Stott

**RRA 453 ADMINISTRATIVE POLICIES AND PROCEDURES** 3 (3-0) F S  
Prerequisite: RRA 359

This course is involved with: the internal organization of the recreation and park department; the administrative process; legislation and legal foundations; boards and commissions; personnel practices and policies; office management; public relations. Mr. Sternloff

**RRA 454 RECREATION AND PARK FINANCE** 3 (3-0) F S  
Prerequisites: Six hours recreation resources administration, senior standing

This course is involved with: recreation and park fiscal administration; sources of finance for current and capital expenditures; revenue activities; financial planning; budgeting; expenditure policies; accounting; auditing and planning for recreation and park services. Mr. Hines

**RRA 475 RECREATION AND PARK INTERNSHIP** 9 (0-27)  
Prerequisites: Senior standing, RRA 359 (9 weeks) S Sum.

This course is intended to provide the prospective recreator with an opportunity to acquire controlled experiences in skills and techniques involved in the management of a recreation and park department. The student will spend nine weeks off campus in a departmental selected location. Mr. Smith

**RRA 491 SPECIAL PROBLEMS IN RECREATION****3 (2-2) F S**

Prerequisite: Consent of department

A survey of specific problems in recreation. Aims to develop critical analysis. Forms a basis for the organization of research projects, for the compilation and organization of material in a functional relationship and for the foundation of policies. Follows the seminar procedure.

**Mr. Miller****FOR GRADUATES ONLY****RRA 500 THEORIES OF LEISURE AND RECREATION****3 (3-0)**

Prerequisites: Nine hours recreation resources administration courses

**RRA 501 THEORY DEVELOPMENT IN RECREATION RESEARCH****4 (3-2)**

Prerequisites: ST 311, SOC 416

**RRA 538 RECREATION FOR SPECIAL POPULATIONS****3 (3-0)**

Prerequisite: Instructor's approval

**RRA 691 SEMINAR IN RECREATION ADMINISTRATIVE POLICIES****2 (0-4)****RRA 692 ADVANCED PROBLEMS IN RECREATION****Credits Arranged****RRA 699 RESEARCH IN RECREATION****Credits Arranged****RELIGION****(Also see Philosophy)****FOR UNDERGRADUATES****REL 300 INTRODUCTION TO RELIGION****3 (3-0) F S**

Human religiousness is the subject matter of this course. Various aspects of religion are analyzed, such as the development of the great traditions, myth and ritual, religious language and aesthetic form, general world view and salvational motif, and the relation of religion to personal maturity, cultural change, and the social good.

**Staff****REL 311 THE HEBREW BIBLE****3 (3-0) F**

Man's religious quest is explored in the varied Biblical literature of the Hebrews, whose faith and history form a major component of western civilization. The course stresses the development of their religious faith and tradition, but such background matters as geography, archeology, history, and literary problems are also considered.

**Mr. Highfill****REL 312 CHRISTIAN ORIGINS****3 (3-0) S**

The Biblical writings of the early Christian community are examined in their historical context. The results of recent studies of the Dead Sea Scrolls as well as of Hellenistic and Hebrew thought and religion are brought to bear on early Christian life and thought.

**Mr. Highfill****REL 315 WESTERN RELIGIONS TO THE REFORMATION****3 (3-0) F**

This course traces the major steps in the development of Christianity and Judaism during the period 100-1500 A.D., noting the events, persons, and ideas which were most significant in this development. Among the topics discussed are the formation of theology and organization, the ecumenical councils, and the heretical movements in the early centuries; the Eastern churches; the challenge of Islam and the Crusades; and the cycles of decline and revival in the church of Western Europe.

**Mr. Fitzgerald**

**REL 316 WESTERN RELIGIONS SINCE THE REFORMATION****3 (3-0) S**

In this course are considered the major developments within Christianity and Judaism from 1500 to the present. Among the topics of study are the Reformation and the rise of Protestantism, religious thought in the intellectual climate of the Enlightenment, and the religious responses to the new challenges of the 19th and 20th centuries.

**Mr. Fitzgerald****REL 321 RELIGION IN AMERICAN LIFE****3 (3-0) F S**

This is a study of representative men, movements, and thought in the major religions within the American context. The course traces the historical development of these religious groups and examines the role of religion in the development of American society and culture.

**Mr. Middleton****REL 325 (ENG 325) RELIGION AND THE MODERN LITERARY IMAGINATION****3 (3-0) F**

This course examines the relationship between religion and imaginative literature by exploring in concrete and dramatic form, a variety of options on such themes as the origins and functions of belief, the reality of God, the nature of man, the problem of evil and suffering, the role of the imagination, and the quest for meaning in human existence.

**Mr. Forrer****REL 327 CONTEMPORARY RELIGIOUS THOUGHT****3 (3-0) F S**

This course investigates the development of recent religious and theological thought in America and Europe, as it has responded to the rapidly changing intellectual, scientific, and social dimensions of Western culture. Among the topics considered are: secularization, existentialist theologies, the death of God, the theology of hope, process theology, de-mythologization, theology of play and festivity, and various theologies of culture.

**Messrs. Fitzgerald, Stalnaker****REL 331 HINDUISM AND ISLAM****3 (2-0) F**

The rich religious traditions of India are studied, including early Vedic religion, Brahmanism, the various Yogas, the devotion cults, the religio-philosophical traditions, modern religious movements, and also separatist traditions such as those of the Jains and Sikhs. Islam, the religious tradition of about ten percent of the Indian population, is examined in its Arabian origins and as it has developed in other parts of the world.

**Mr. Highfill****REL 332 BUDDHISM****3 (3-0) S**

Buddhism, the integrating religious force in Asia, is followed from its beginnings in India through the expansion into the whole of Asia, including China, Japan and Southeast Asia. Creativity in art, political involvements, the role of the monastic community, meditative disciplines, as in Zen, and new sects, as in Japan, are some of the facets of this study.

**Mr. Highfill****REL 498 SPECIAL TOPICS IN RELIGION****1-6 F S**

Prerequisites: Six hours religion

This course has no fixed description and is used to offer areas of study which appear only rarely in the curriculum. It will also function as a readings course for honors students in religion.

**Staff****REL 590 (EM 590, PHI 590) TECHNOLOGY AND HUMAN VALUES****3 (0-3) F S**

Prerequisites: A baccalaureate degree in a recognized field of engineering, liberal arts, science or social science; or, for advanced undergraduates in these fields, two or more courses such as Technology in History (HI 341), Science and Civilization (UNI 301, 302), Contemporary Issues (UNI 401), or six credit hours in philosophy

The purposes of the course are: (1) To explore from two or more disciplinary perspectives (notably those of ethical theory and cybernetic information theory)

the range of possible ways of conceptualizing the relationship between the technologies of a society and the values of that society; (2) In areas of particular interest to students, to analyze in detail contemporary instances of the inter-relation of technology and human values. Staff

## **SOCIOLOGY**

**(Also see Anthropology)**

### **FOR UNDERGRADUATES**

#### **SOC 202 PRINCIPLES OF SOCIOLOGY**

**3 (3-0) F S**

Introduction to the scientific study of man's behavior in relation to other men, the general laws affecting the organization of such relationships and the effects of social life on human personality and behavior.

#### **SOC 203 SOCIAL WELFARE IN THE UNITED STATES**

**2 (2-0) S**

Introduction of students to current social welfare programs in the United States. Major agencies and programs providing financial, protective, educational, medical, legal, recreational, rehabilitative, manpower training and employment and supportive services. Study of the development of these programs including the motivations of individuals and groups which initiated them. Small teams of students will plan and conduct study of selected programs, their philosophy, structure and service delivery methods, effectiveness, and share findings with the total class.

#### **SOC 205 SOCIAL WELFARE POLICIES AND ISSUES**

**3 (3-0) S**

Prerequisites: SOC 203

An examination of policies and issues associated with existing social welfare delivery systems with emphasis given to policy formulation and assessment of alternative strategies for establishing and meeting social goals. Influence of social work principles, values and practice on social welfare policies and issues.

#### **SOC 301 HUMAN BEHAVIOR**

**3 (3-0) F S**

A study of the effects of social interaction upon individual behavior and personality; collective attitudes and behavior as products of group experience; analysis of fashions and fads, crowds, mobs, publics, social movements.

#### **SOC 302 MASS COMMUNICATIONS AND MODERN SOCIETY**

**3 (3-0) F S**

The development and composition of social groups and the processes involved in group organization. These are analyzed in terms of the expanding functions of mass communication in contemporary society.

#### **SOC 303 CURRENT SOCIAL PROBLEMS**

**3 (3-0) F S**

Study of the social and cultural aspects of specific problems such as crime, divorce, race conflicts, illness, poverty, housing, recreation and personality adjustment to demonstrate the basic integration of society and community life.

#### **SOC 304 CONTEMPORARY FAMILY LIFE**

**3 (3-0) F S**

The social organization of the family with special attention to socialization, marital choice, kinship relations and the social changes affecting family structure and functions.

#### **SOC 305 RACE RELATIONS**

**3 (3-0) F S**

Analysis of race relationships both in the United States and throughout the world with particular emphasis on factors producing the changes taking place at the present time.

**SOC 306 CRIMINOLOGY****3 (3-0) F S**

The study of causation, treatment, prevention and control of criminality and juvenile delinquency. Special emphasis is placed on sociocultural theories of causation and on the examination of court and correctional systems for adults and juveniles. Arranged field trips.

**SOC 307 SOCIAL WORK PROGRAMS AND DELIVERY SYSTEMS****3 (3-0) F**

Prerequisite: SOC 205 or permission of instructor

An in-depth study of major social welfare programs currently in operation from the viewpoint of social work values, functions and methods. Focus is on income maintenance, preventive, protective and rehabilitative services for the aged, families and children and handicapped persons. Program content and methods of service delivery will be explored in class and by small teams of students to determine the effectiveness of financial and non-financial programs.

**SOC 308 SOCIAL WORK PRACTICE AND METHODS I****3 (3-0) S**

Prerequisite: SOC 307

Selected fundamental elements of the social work process will be studied. These include worker-client relationships, interviewing, information collection, analysis and case (individual or group) recording and case planning.

**SOC 315 SOCIAL THOUGHT****3 (3-0) F S**

Prerequisite: SOC 202 or equivalent

The development of social thought from lore to science; historical changes in explanatory systems of human behavior; theories of the individual, group culture community and society; the emergence of sociological systems of analysis; the role of the sociologist in the study of social phenomena including planned change.

**SOC 318 (ED 318) EDUCATIONAL SOCIOLOGY****3 (3-0) F S**

Prerequisites: Three hours sociology

An investigation of the educational institution in a sociological framework. Analyzes the school as a social system, roles of the functionaries of education, relationships within the student body, effects of social factors upon the learning experience, reciprocal school-community relationships, adult education and higher education in American society.

**SOC 341 RURAL SOCIETY—U.S.A.****3 (3-0) F S**

Prerequisite: SOC 202 or equivalent

The application of basic sociological concepts to rural life. Major rural social institutions, ecological patterns and land tenure systems are examined with emphasis upon the American setting. Influence of rural patterns and values in contemporary urbanized society is examined. Stress is placed upon the role of the rural community as an area of institutional functioning and social integration within the framework of a complex, industrial society.

**SOC 342 RURAL SOCIETIES AROUND THE WORLD****3 (3-0) F S**

Prerequisite: SOC 202 or equivalent

Sociological description, analysis and understanding of traditional rural societies of Asia, Africa and Latin America. Basic social institutions, groupings and processes are examined to provide bases for understanding these societies in the context of an increasingly urbanized and industrialized world. Major emphasis is placed on examining these societies on a Gemeinschaft-Gesellschaft continuum.

## FOR ADVANCED UNDERGRADUATES

SOC 401 HUMAN RELATIONS IN INDUSTRIAL SOCIETY 3 (3-0) F S

Prerequisites: Senior standing, consent of instructor

Studies in the sociology of occupations, professions and work with special attention to human relations in industrial plants and other work situations.

SOC 402 URBAN SOCIOLOGY 3 (3-0) F S

Prerequisite: SOC 202 or consent of instructor

A study of the factors in the growth of cities; the relationship between the design of cities and their social organization; detailed analysis of new developments in the serving of human needs. City and regional planning.

SOC 405 SOCIAL WORK PRACTICE AND METHODS II 3 (3-0) F

Prerequisites: SOC 308, consent of instructor

A course designed to acquaint students with the various types of public and voluntary social work and with remedial and preventive programs in applied sociology, social psychiatry, health, public welfare and recreation.

SOC 406 FIELD WORK I 4 (1-8) F

Prerequisite: SOC 308

Corequisite: SOC 405

Field instruction in a public or voluntary social welfare agency or community program for one full day each week. Observation of agency or program operation, interaction with individuals and small groups with application of social work values, skills, objectives, and methods from classroom work.

SOC 407 FIELD WORK II 4 (1-8) S

Prerequisite: SOC 406

Field work instruction for one day each week of the semester in a social agency or program. Further application and testing of social work knowledge acquired in classroom work and from previous field placement in dealing with problems experienced by individuals, groups and communities.

SOC 411 COMMUNITY RELATIONSHIPS 3 (3-0) F S

Prerequisites: SOC 202, consent of instructor

A survey of the institutions, organizations and agencies found in modern communities; social problems and conditions with which they deal; their interrelationship and the trend toward over-all planning.

SOC 414 SOCIAL STRUCTURE 3 (3-0) F S

Prerequisites: Six hours sociology, consent of instructor

Studies of the major social institutions and systems of stratification; the organization of social studies of the major social institutions and systems of stratification; the organization of social systems as, for example, religion, education and government; the functions of such structural components as age and sex groups, vocational and professional groups, and social classes.

SOC 416 RESEARCH METHODS 3 (3-0) F S

Prerequisite: Six hours sociology and ST 311 or nine hours sociology

An analysis of the principal methods of social research; the development of experiments; schedules and questionnaires; the measurement of behavior.

SOC 425 JUVENILE DELINQUENCY 3 (3-0) F S

Prerequisite: SOC 306 or six hours social science

The epidemiology of juvenile delinquency is explored. Descriptive typologies are compared. Theories of causation are developed with emphasis on social institutions,

peer groups and socialization processes. Procedures for enforcement, adjudication and correction of young offenders are investigated. Strategies for prevention of delinquency are examined. Opportunities for observation and participation in agency operations are included.

**SOC 451 POPULATION AND PUBLIC AFFAIRS** 3 (3-0) F S  
Prerequisite: SOC 202 or equivalent

Growth rates, changing composition and residential redistribution are studied in relation to public issues and planning. Attention is given to the ways in which population data are utilized by public agencies in program and policy formulation. Analysis encompasses new problems and socioeconomic situations which develop as a consequence of the dynamic nature of population changes in contemporary society.

**SOC 490, 491 SENIOR SEMINAR IN SOCIOLOGY** 3 (3-0) F S  
Prerequisite: Consent of department

This course is of an integrative nature giving the student an opportunity to synthesize knowledge, theory and methods learned in earlier courses and to conduct original explorations in areas of special interest.

**SOC 494, 495 (EC 494, 495, PS 494, 495) URBAN SEMINAR** 3 (3-0) F S  
(See politics, page 431.)

**SOC 498 SPECIAL TOPICS IN SOCIOLOGY** 1-6 F S  
Prerequisite: Six hours sociology above the freshman level

The student will make a detailed investigation of a special topic in sociology or anthropology. The topic and mode of study will be determined by the faculty member(s) in consultation with the head of the Department of Sociology and Anthropology.

## **FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**SOC 501 (ED 501) LEADERSHIP** 3 (3-0) F S  
Prerequisite: SOC 202 or equivalent

A study of leadership in various fields of American life; analysis of the various factors associated with leadership; techniques of leadership. Particular attention is given to recreational, scientific and executive leadership procedures.

**SOC 502 SOCIETY, CULTURE AND PERSONALITY** 3 (3-0) F S  
Prerequisite: SOC 202 or equivalent

Human personality is studied from its origins in primary groups through its development in secondary contacts and its ultimate integration with social norms. While comparative anthropological materials will be drawn upon, emphasis is placed upon the normal personality and the adjustment of the individual to our society and to our culture. The dynamics of personality and character structure are analyzed in terms of the general culture patterns and social institutions of society.

**SOC 503 CONTEMPORARY SOCIOLOGY** 3 (3-0) F S  
Prerequisite: Graduate standing

The basic purpose of this course is to provide the student with an overview of the current status of sociological theory and research. It will introduce the student to contemporary sociological thinking and research and provide a base for further graduate training in the discipline.

**SOC 504 EDUCATION IN MODERN SOCIETY** 3 (3-0) F S  
Prerequisite: SOC 202, SOC 301 or equivalent

Analysis of education using basic sociological concepts. Varying emphasis will be placed upon the historical development of education in the United States cross-cultural comparisons of educational structure and function, professionalization of educators, investigation of the ecological factors affecting education, effects of group processes upon learning, and the effects of social processes and changes upon the educational institution.

**SOC 505 THE SOCIOLOGY OF REHABILITATION I**

3 (3-0) F

Prerequisite: Graduate standing and/or consent of instructor

The area of disability and handicap is introduced from a conceptual and theoretical standpoint. Sociological and social-psychological aspects of handicaps, the rehabilitation processes and rehabilitative organizations are stressed throughout. Particular attention is given to rehabilitation of the sociology of work in the rehabilitation processes. Socio-cultural factors in disability and handicap (residence, social class, family relationships, etc.) are analyzed in depth.

**SOC 506 THE SOCIOLOGY OF REHABILITATION II**

3 (3-0) S

Prerequisite: Graduate standing and/or consent of instructor

Students will be expected to engage in individual research projects on a specific handicap, a rehabilitation process or a rehabilitative agency or subagency. An attempt will be made through lectures and discussions to give the student perspective concerning the actual work of rehabilitation in process while he is pursuing his specialized interest. Emphasis will be placed on sociological methods and techniques applicable to the study of the above aspects of social behavior.

**SOC 509 POPULATION PROBLEMS**

3 (3-0) F S

Prerequisite: SOC 202 or equivalent

A study of population growth, rates of change and distribution. Considerable attention is given to the functional roles of population, i.e., age, sex, race, residence, occupation, marital status and education. The dynamic aspects of population are stressed: fertility, mortality and migration. Population policy is analyzed in relation to national and international goals. A world view is stressed throughout.

**SOC 510 INDUSTRIAL SOCIOLOGY**

3 (3-0) F S

Prerequisite: SOC 202 or equivalent

Industrial relations are analyzed as group behavior with a complex and dynamic network of rights, obligations, sentiments and rules. This social system is viewed as an interdependent part of total community life. The background and functioning of industrialism are studied as social and cultural phenomena. Specific social problems of industry are analyzed.

**SOC 511 SOCIOLOGICAL THEORY**

3 (3-0) F S

Prerequisites: Six hours sociology and graduate standing or consent of instructor

Study of the interdependence of theory and method; the major theoretical and methodological systems; and examination of selected cases of research in which theory and method are classically combined.

**SOC 512 FAMILY ANALYSIS**

3 (3-0) F S

Prerequisite: SOC 202 or equivalent

This course examines the basic theoretical and methodological framework in sociology within which contemporary family research is conducted.

**SOC 513 (ED 513) COMMUNITY ORGANIZATION**

3 (3-0) F S

Prerequisite: SOC 202 or equivalent

Community organization is viewed as a process of bringing about desirable changes in community life. Community needs and resources available to meet

these needs are studied. Democratic processes in community action and principles of community organization are stressed, along with techniques and procedures. The roles of leaders, both lay and professional, in community development are analyzed.

**SOC 514 DEVELOPING SOCIETIES**

**3 (3-0) F S**

**Prerequisites:** Six hours sociology or anthropology or graduate standing

The purpose of this course is to define the major problems posed for development sociology and to explore the sociological barriers and theoretical solutions for development set forth with special regard to the newly-developing countries. Significant past strategies will be reviewed as well as main themes in current development schemes. Finally, some untested strategies for the future will be proposed for discussion. These problems will be examined in their national and international contexts.

**SOC 515 DEVIANT BEHAVIOR**

**3 (3-0) F S**

**Prerequisite:** Six hours of sociology or anthropology or graduate standing

Major topics include: the inevitability of deviance and its social utility; cross-cultural variations in appearance and behavioral cues for labeling the deviate; descriptive and explanatory approaches to kinds and amounts of deviance in contemporary American society; social change, anomie and social disorganization theories; the process of stigmatization; formal and informal societal responses to deviance and the deviate; social action implications. There is no other graduate course presently offered in deviant behavior.

**SOC 517 (PS 517) THE POLICE BUREAUCRACY IN A DEMOCRATIC SOCIETY**

**3 (3-0) F S**

(See politics, page 434.)

**SOC 523 SOCIOLOGICAL ANALYSIS OF AGRICULTURAL LAND  
TENURE SYSTEMS**

**3 (3-0) F S**

**Prerequisite:** Three hours sociology

A systematic sociological analysis of the major agricultural and land-tenure systems of the world with major emphasis on the problems of family farm ownership and tenancy in the United States.

**SOC 533 THEORY OF HUMAN COMMUNICATION BEHAVIOR**

**3 (3-0) F S**

**Prerequisites:** Six hours sociology or social psychology and graduate standing

This course is organized to introduce students to the behavioral science approach to an understanding of human communication. Communication is treated as a basic social psychological process in which communication events are analyzed in terms of their effects on individual, interpersonal and group behavior. Students will survey the theory, research methods and empirical findings developed in the emerging field of communication. Communication behavior is treated as a mediating mechanism is social interaction.

**SOC 534 AGRICULTURAL ORGANIZATIONS AND MOVEMENTS**

**3 (3-0) F S**

**Prerequisites:** Three hours sociology, American history, American government or a related social science or consent of department

A history of agricultural organizations and movements in the United States and Canada principally since 1865, emphasizing the Grange, the Farmers Alliance, the Populist revolt, the Farmers' Union, the Farm Bureau, the Equity societies, the Nonpartisan League, cooperative marketing, government programs and present problems.

**SOC 541 SOCIAL SYSTEMS AND PLANNED CHANGE**

**3 (3-0) F S**

**Prerequisite:** Three hours sociology

A study of social agencies and programs and their implementation through specific organizations in dynamic relation with the people whom they serve. Consideration is given to the relation of these agencies and programs to community

structure and forces in society; coordination of the several types of agencies and programs, professional leadership and participation.

**SOC 555 SOCIAL STRATIFICATION**

**3 (3-0) F S**

Prerequisite: Six hours sociology

In this course the student would be introduced to the theoretical background, the methodological approaches, and the analysis of the consequences of systems of stratification. Emphasis would be on the static and dynamic qualities of stratification systems in rural and urban-industrial societies as well as the effects of these systems on relations within and between societies. Particular attention will be paid to the integrative and divisive quality of stratification as it is expressed in life styles, world views, etc.

**SOC 560 RACIAL AND CULTURAL CONTACTS**

**3 (3-0) F S**

Prerequisite: Six hours sociology or consent of instructor

The course is organized in three sequential sections, the first of which deals with intergroup relations as a legitimate concern of the social sciences. The second consists of an appraisal of cross-cultural data that have been drawn from a variety of situations wherein race and ethnicity figure in a significant manner. Finally, an effort is made to interpret data by delineating observable patterns, trends and relationships.

**SOC 565 SOCIOLOGY AND GENERAL SYSTEMS THEORY**

**3 (3-0) F S**

Prerequisites: Six hours sociology, one course in statistics

In this course the student would study the basis of general systems theory and review its application in the field of sociology. Emphasis would be placed on the philosophical nature of systems theory and its potential as an alternative conceptualization to mechanistic and organismic models. Attention will be given to the underlying basis of systems theory; to cybernetics as models of change and control; learning and equilibrium; to information theory as models of choice and selection; to decision theory, and to game theory.

**SOC 574 (EC 574) THE ECONOMICS OF POPULATION**

**3 (3-0) F S**

(See economics, page 300.)

**SOC 590 APPLIED RESEARCH**

**3 (3-0) F S**

Prerequisite: SOC 202 or equivalent

A study of the research process with particular emphasis upon its application to action problems. The development of research design to meet action research needs receives special attention.

**SOC 591 SPECIAL TOPICS IN SOCIOLOGY**

**6 (6-0) F S**

Prerequisite: Consent of instructor

An examination of current problems in sociology organized on a lecture-discussion basis. The content of the course will vary as changing conditions require the use of new approaches to deal with the emerging problems.

**SOC 592 DEMOGRAPHIC STRUCTURE AND PROCESSES**

**3 (3-0) S**

Prerequisite: 509 or equivalent

The basic purpose of this course is to provide the student an opportunity to explore, in depth, the major demographic variables (size, composition and distribution) and basic demographic processes (fertility, mortality and migration). Attention will be given both to theoretical and methodological considerations as well as to current substantive knowledge. The specific content of the course will vary from semester to semester depending on the needs and interests of the students.

## FOR GRADUATES ONLY

SOC 601	URBAN ECOLOGY	3 (3-0) S
SOC 611	RESEARCH METHODS IN SOCIOLOGY	3 (3-0) F S
SOC 613	THEORY OF MASS COMMUNICATION	3 (3-0) F S
SOC 621	SOCIAL PSYCHOLOGY	3 (3-0) F S
SOC 631	POPULATION ANALYSIS	3 (3-0) F S
SOC 632	SOCIOLOGY OF THE FAMILY	3 (3-0) F S
SOC 633	THE COMMUNITY	3 (3-0) F S
SOC 641	STATISTICS IN SOCIOLOGY	3 (3-0) F S
SOC 652	COMPARATIVE SOCIETIES	3 (3-0) F S
SOC 653	THEORY AND DEVELOPMENT OF SOCIOLOGY	3 (3-0) F S
SOC 670	THEORIES OF POPULATION	3 (3-0) F
SOC 671	SOCIAL DEMOGRAPHY	3 (3-0) F S
SOC 690	SEMINAR	Credits Arranged F S
SOC 699	RESEARCH IN SOCIOLOGY	Credits Arranged

## SOIL SCIENCE

### FOR UNDERGRADUATES

SSC 112 (CS 112)	PERSPECTIVES IN AGRONOMY	2 (0-5) S
(See crop science, page 288.)		
SSC 200	SOILS	4 (3-3) F S
Prerequisite: CH 101; CH 103 or taken concurrently; GY 120 recommended		
Fundamentals of soil science: origin, composition and classification of soils; their physical, chemical, and biological properties; significance of these properties to soil-plant relationships and soil management.		
		Messrs. Cook, Raper
SSC 341	SOIL FERTILITY AND FERTILIZERS	3 (3-0) F
Prerequisites: SSC 200, BS 100		
History of plant nutrition and soil fertility; plant nutrition and growth as related to crop fertilization; fertilizer materials, their manufacture, properties, and usage; fertilizer practices related to a sound soil management program.		
		Mr. Terry
SSC 452	SOIL CLASSIFICATION	3 (2-3) S
Prerequisite: SSC 200		
Presentation of factors involved in the genesis, morphology and classification of soils, emphasis upon soil profile properties as operational criteria in the modern classification system; practical field problem in recognition and mapping of soils.		
		Messrs. Cook, Phillips

**SSC 461 SOIL AND WATER CONSERVATION****3 (3-0) F**

Prerequisite: SSC 200 or equivalent

The history and status of erosion and fertility conditions, the economic and social aspects of soil conservation; the effects of climatic factors, vegetation (forest, sod crops, cover crops and soil rotations), soil properties, and other management practices on soil conservation and fertility maintenance.

Mr. Lutz

**SSC 462 SOIL MANAGEMENT SYSTEMS****3 (2-3) S**

Prerequisites: SSC 341, SSC 452, SSC 461, CS 211, EC 212

A comprehensive course uniting the subject matter of preceding undergraduate soil science courses with that of allied areas into realistic soil management applications; practical field studies in planning and evaluation of soil management systems.

Mr. Sopher

**SSC 472 FOREST SOILS****3 (2-3) S**

Prerequisites: SSC 200, SSC 341, or FOR 452 or equivalent

Soil as a medium for tree growth; the relation of soil physical, chemical, and biological factors to the practice of silviculture; extensive soil management in the forest and intensive soil management in forest nurseries and in seed-tree orchards; the relation of soil and site to current work in genetics, ecology, pathology, and entomology.

Mr. Wollum

**SSC 492 SENIOR SEMINAR IN SOIL SCIENCE****1 (1-0) S**

Prerequisite: Senior standing in the School of Agriculture and Life Sciences

A student participation course in which students prepare and present thorough and documented discussions of important soil topics.

Staff

**FOR GRADUATES AND ADVANCED UNDERGRADUATES****SSC 501 TROPICAL SOILS: CHARACTERISTICS AND MANAGEMENT****3 (3-0) F**

Prerequisite: Six credits in soil science

Principles of soil science in relation to increasing food production in the tropics; characteristics of soils of tropical rain forests, savannas, deserts, and alluvial plains; soil-plant-fertilizer relations in tropical soil management systems.

Mr. Sanchez

**SSC 511 SOIL PHYSICS****4 (3-3) F**

Prerequisites: SSC 200, PY 212

Physical constitution and analyses; soil structure, soil water, soil air, and soil temperature in relation to plant growth.

Mr. Lutz

**SSC 520 SOIL AND PLANT ANALYSIS****3 (1-6) S**

Prerequisites: PY 212, CH 315, at least three soils courses including SSC 341 or permission of instructor

Analytical techniques and chemical instrumentation employed in analysis of soils and plants. Applications to research are emphasized.

Mr. Gilliam

**SSC 522 SOIL CHEMISTRY****3 (3-0) S**

Prerequisites: SSC 200, and one year general inorganic chemistry

A consideration of the chemical and colloidal properties of clay and soil systems, including ion exchange and retention, soil solution reactions, solvation of clays, and electrokinetic properties of clay-water systems.

Mr. Weed

**SSC 532 (MB 532) SOIL MICROBIOLOGY****3 (3-0) S**

Prerequisites: CH 220, MB 401

The more important microbiological processes that occur in soils, decomposition of organic materials, ammonification, nitrification, and nitrogen fixation.

Mr. Wollum

SSC 541 SOIL FERTILITY	3 (3-0) F
Prerequisite: SSC 341	
Soil conditions affecting plant growth and the chemistry of soil and fertilizer interrelationships; factors affecting the availability of nutrients; methods for measuring nutrient availability.	
	Mr. Kamprath

SSC 551 SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION	3 (3-0) F
Prerequisites: SSC 200, SSC 341, GY 120	

Morphology: study of concepts of soil horizons and soil profiles and chemical, physical and mineralogical parameters useful in characterizing them; Genesis: critical study of soil forming factors and processes; Classification: critical evaluation of historical development and present concepts of soil taxonomy with particular reference to great soil groups as well as discussion of logical basis of soil classification.

Mr. Buol

SSC 553 SOIL MINERALOGY	3 (2-3) F
Prerequisites: SSC 200, SSC 341, GY 331, or equivalent	

Composition, structure, classification, identification, origin, occurrence, and significance of soil minerals with emphasis on primary weatherable silicates, layer silicate clays, and sesquioxides.

Mr. Cook

SSC 560 ADVANCED SOIL MANAGEMENT	3 (3-0) Sum.
Prerequisites: SSC 200, SSC 341	

Field studies of selected soil series in the Coastal Plain, Piedmont and Mountain areas of North Carolina; discussion of management practices that should be associated with the various soils under different types of farming. (Offered 1973 and alternate years.)

Staff

SSC 590 SPECIAL PROBLEMS	Credits Arranged F S
Prerequisite: SSC 200	

Special problems in various phases of soils; emphasis placed on review of recent and current research.

Staff

## FOR GRADUATES ONLY

SSC 614 (CS 614, HS 614) HERBICIDE BEHAVIOR IN PLANTS AND SOILS	3 (3-0) F
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SSC 622 SOIL PHYSICAL CHEMISTRY	3 (3-0) S
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SSC 632 (MB 632) ECOLOGY AND FUNCTIONS OF SOIL MICROORGANISMS	3 (3-0) S
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SSC 651 PEDOLOGY	3 (3-0) F
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SSC 671 (BAE 671) THEORY OF DRAINAGE—SATURATED FLOW	3 (3-0) Alternate F
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SSC 672 SOIL PROPERTIES AND PLANT DEVELOPMENT	3 (3-0) S
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SSC 674 (BAE 674) THEORY OF DRAINAGE—UNSATURATED FLOW	3 (3-0) Alternate F
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SSC 690 SEMINAR	1 (1-0) F S
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SSC 693 COLLOQUIUM IN SOIL SCIENCE	Credits Arranged F S
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SSC 699 RESEARCH	Credits Arranged F S
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# SPEECH

(Also see English)

*NOTE: The prerequisite for all advanced courses in speech is the completion of ENG 111 and ENG 112 with a grade of C or better in at least one semester.*

## FOR UNDERGRADUATES

### SP 210 VOICE AND ARTICULATION 3 (3-0) F S

A study of the basic processes of the production of speech. Attention given to student's voice quality, articulation, pronunciation and general vocal expression. Speech improvement; help in recognition and reduction of excessive regional sub-standard dialect. Elective for the general student; also required by the School of Education. (Meets requirement of N. C. Department of Public Instruction for Certification of speech proficiency for teachers in *all fields*, except speech. SP 310 required for speech teachers.) Staff

### SP 230 FUNDAMENTALS OF SPEECH 3 (3-0) F S

Directed experience in the various skills of oral communication; public speaking, group discussion and interpretative reading. Must be taken only as a first course in speech and only in sequence. Staff

### SP 231 EXPOSITORY SPEAKING 3 (3-0) F S

A study of the basic theories of informative, report and instructional speaking. Basic rhetorical, audience and idea analysis as well as the delivery of short expository speeches are stressed. Staff

### SP 232 PERSUASIVE SPEAKING 3 (3-0) F S

A study of the principles of influencing attitudes and actions through persuasive speaking, with emphasis upon short speeches to stimulate, convince and actuate. Staff

### SP 237 GROUP DISCUSSION 3 (3-0) F S

The theory and practice of leading and taking part in such groups as panels, forums, symposiums, conferences and committees. Staff

### SP 310 PHONETICS 3 (3-0) F S

A study of the anatomy and movement of the vocal organs in the production of the sounds of speech. Application of the International Phonetic Alphabet to standards of American pronunciation. Study of the major dialect areas of the United States. Recommended as an elective for English majors. Staff

### SP 311 INTRODUCTION TO SPEECH CORRECTION 3 (3-0) S Prerequisite: SP 310

A study of the development of normal speech and hearing. Common speech and hearing defects, and the basic techniques for their prevention and treatment are emphasized. Staff

### SP 332 ARGUMENTATION AND DEBATE 3 (3-0) F

A study of the process of influencing opinion through the use of logical arguments, with emphasis upon analysis, briefing, evidence, reasoning and refutation. In-class debating also included. Staff

### SP 336 PARLIAMENTARY PRACTICE 3 (3-0) F S

Rules and customs of assemblies, including organization, motions; participation in and conduct of meetings; parliamentary strategy. Staff

**SP 340 PLAY PRODUCTION****3 (3-0) F S**

A survey of methods and techniques in staging dramatic art. Organizing, play selection, casting, directing, acting, scene designs and construction, lighting.

**Staff****SP 350 FUNDAMENTALS OF RADIO BROADCASTING****3 (2-2) F**

A beginning audio production course with laboratory work suitable for both inexperienced and advanced students. Lectures, discussions and demonstrations are arranged to examine the elements of advertising, business, engineering, journalism, politics and show business relevant to American radio broadcasting.

**Staff****SP 351 RADIO PRODUCTION****3 (2-2) S**

Prerequisite: SP 350 or consent of instructor

An advanced course in writing and production for radio. Copy writing, news writing and more complex writing assignments lead to a recorded individual "special" program which is evaluated by the instructor and by the class. The best programs may be broadcast over area radio stations.

**Staff****SP 361 ORAL READING****3 (3-0) F S**

The analysis and presentation of printed materials—literary, technical and semitechnical—for platform, radio and television.

**Staff****SP 420 DEVELOPMENT OF RHETORICAL THEORY****3 (3-0) F S**

A study of the development of rhetorical theory through the Greek, Roman, medieval, renaissance and modern periods.

**Staff****SP 430 HISTORY AND CRITICISM OF AMERICAN PUBLIC ADDRESS****3 (3-0) F S**

A study of the significant political and social speakers in American from colonial times to the present. Analyses of the social settings, of the speeches themselves, and of their impact upon American history are stressed.

**Staff****SP 450 FUNDAMENTALS OF TELEVISION PRODUCTION****3 (1-4) F**

An introduction to the philosophy and techniques of television production. Particular attention is given to instructional and informational programming. Lectures consider television as a communication medium in contemporary society. Laboratory sessions involve the student in studio production of 30-minute television programs. The term project requires each student to "structure," produce and direct a 30-minute program for taping and critique by teacher, professionals and class.

**Staff****SP 451 ADVANCED TELEVISION PRODUCTION****3 (2-2) S**

Prerequisite: SP 450 or consent of instructor

An intermediate course in television and media techniques and applications. For speech-communication majors, teacher trainees and others of advanced standing who already have a general knowledge about the operation and basic function of these media.

Lectures relate to advanced theories of media and message. Laboratory periods result in student productions that are analyzed and evaluated in regard to advanced criteria of artistic excellence.

**Staff****SP 496 SEMINAR IN SPEECH COMMUNICATION****3 (3-0) S**

Prerequisite: Consent of department

A research-oriented study of the major periods, movements and personalities in the field of oral communication. Intended to encourage the student to synthesize some aspect of his preceding work in speech.

**Staff**

# STATISTICS

## FOR UNDERGRADUATES

### ST 311 INTRODUCTION TO STATISTICS

3 (3-0) F S

This course relates general statistical concepts to everyday life and emphasizes giving perspective to those concepts: quantitative descriptions of populations, some sampling ideas, techniques of making inferences from samples, and the uncertainties involved in making statistical inferences.

Messrs. Hafley, McVay, Stines

### ST 361 INTRODUCTION TO STATISTICS FOR ENGINEERS

3 (3-0) F S

Prerequisite: College algebra

Survey of statistical techniques useful to engineers and physical scientists. Includes elementary probability, frequency distributions, sampling variation, estimation of means and standard deviations, confidence intervals, significance tests, elementary least squares curve fitting.

Staff

### ST 371 INTRODUCTION TO PROBABILITY AND STATISTICS

4 (4-0) F S

Prerequisite: MA 201

Basic concepts of probability and statistics for students in the physical sciences and engineering; simple probability models, random variables, distributions, functions of random variables, sampling, data description, testing hypotheses, estimation; simple applications of concepts; tests of means, variances, goodness-of-fit, randomness, control charts, analysis of variance, regression.

Messrs. Grandage, Manson, Quesenberry

## FOR ADVANCED UNDERGRADUATES

### ST 421, 422 INTRODUCTION TO MATHEMATICAL STATISTICS

3 (3-0) F S

Prerequisite: MA 202 or MA 212 or MA 232

Elementary mathematical statistics primarily for students not intending to take further work in theoretical statistics. Includes introduction to probability, common theoretical distributions, moments, moment generating functions, sampling distributions (F, t, chi-square), elementary estimation, hypothesis testing concepts, decision theory concepts and elements of general linear model theory.

Messrs. Giesbrecht, Gallant

## FOR GRADUATES AND ADVANCED UNDERGRADUATES

### ST 501, 502 BASIC STATISTICAL ANALYSIS

3 (3-0) F S

Prerequisite: ST 311 or equivalent or graduate standing

Basic concepts of statistics; random variables, distributions, statistical measures, estimation, tests of significance, analysis of variance, elementary design and sampling, factorial experiments, multiple regression, analysis of discrete data and other topics. Intended primarily for statistics majors and Ph.D. minors and not intended as a service course for other departments.

Mr. Steel

### ST 507 STATISTICS FOR THE BEHAVIORAL SCIENCES I

3 (3-0) F

The purpose of this course is to provide a general introduction to descriptive and inferential statistics. Attention will be paid to investigating the role of statistics in behavioral science research as well as presenting the techniques and principles for summarizing data. A basic introduction to inferential statistics will be made with an emphasis on the concepts of hypothesis testing and decision making. The

principles and methods will be illustrated by examples and problems from the behavioral science fields. Mr. Wasik

ST 508 STATISTICS FOR THE BEHAVIORAL SCIENCES II 3 (3-0) S  
Prerequisite: ST 507 or consent of instructor

The purpose of this course is to provide further consideration of the use of advanced statistical techniques used in decision making in behavioral science research. Attention will be paid to hypothesis testing and analysis of variance procedures used in the design of experiments. A part of the course will be devoted to topics relating to least squares and multiple regression analysis.

Mr. Wasik

ST 511 EXPERIMENTAL STATISTICS FOR BIOLOGICAL SCIENCES I 3 (3-0) F S  
Prerequisite: ST 311 or graduate standing

Basic concepts of statistical models and use of samples; variation, statistical measures, distributions, tests of significance, analysis of variance and elementary experimental design, regression and correlation, chi-square.

Staff

ST 512 EXPERIMENTAL STATISTICS FOR BIOLOGICAL SCIENCES II 3 (3-0) F S  
Prerequisite: ST 511 or equivalent

Covariance, multiple regression, concepts of experimental design, factorial experiments, individual degrees of freedom, confounded factorial and split-plot designs.

Staff

ST 513 EXPERIMENTAL STATISTICS FOR SOCIAL SCIENCES I 3 (3-0) F  
Prerequisite: ST 311 or graduate standing

Basic concepts in collection and analysis of data. Variability of sample data, distributions, confidence limits, chi-square, t-test, analysis of variance, regression, correlation, analytic and descriptive surveys, experimental designs.

Mr. McVay

ST 514 EXPERIMENTAL STATISTICS FOR SOCIAL SCIENCES II 3 (3-0) S  
Prerequisite: ST 513 or equivalent

Extension of basic statistical concepts to social experiments and surveys; sampling from finite populations and estimating, using unrestricted, stratified, systematic and multistage selections; analysis of variance continued; multiple regression; covariance; experimental designs.

Mr. Proctor

ST 515, 516 EXPERIMENTAL STATISTICS FOR ENGINEERS 3 (3-0) F S  
Prerequisite: ST 361 or graduate standing

General statistical concepts and techniques useful to research workers in engineering, textiles, wood technology, etc. Probability, distributions, measurement of precision, simple and multiple regression, tests of significance, analysis of variance, enumeration data, sensitivity data, life-testing experiments and experimental designs.

Mr. Hader

ST 517 APPLIED LEAST SQUARES 3 (3-0) F  
Prerequisite: ST 502 or equivalent

Use of least squares estimation in developing numerical descriptions with linear models. Regression, analysis of variance and covariance are considered in a unified manner that does not require an extensive statistical background. Emphasis is placed on the application of these techniques to experimental situations and in broadening the range of problems to which they can be applied (particularly in terms of unequal numbers of observations).

Staff

ST 521 STATISTICAL THEORY I 3 (2-2) F  
Corequisite: MA 581 for statisticians and MA 405 or permission of instructor

Discussion of the use of statistics as illustrated by an example, pointing out the

need for a probabilistic framework. The probability tools for statistics: description of discrete and absolutely continuous distributions, expected values, moments, moment generating functions, transformation of random variables, marginal and conditional distributions, independence, order statistics, multivariate distributions, concept of random sample, derivation of many sampling distributions.

Mr. van der Vaart

## ST 522 STATISTICAL THEORY II

3 (2-2) S

Prerequisite: ST 521

Corequisite: MA 581 (a continuation of MA 581 in fall semester)

General framework for statistical inference. Point estimators: biased and unbiased, minimum variance unbiased, least mean square error, maximum likelihood and least squares, asymptotic properties. Interval estimators and tests of hypotheses: confidence intervals, power functions, Neyman-Pearson lemma, likelihood ratio tests, unbiasedness, efficiency and sufficiency.

Mr. van der Vaart

## ST 531 DESIGN OF EXPERIMENTS

3 (3-0) F

Prerequisite: ST 502 or equivalent

Review of completely randomized, randomized complete block and Latin square designs, and the basic concepts in the techniques of experimental design. Designs and analysis methods in factorial experiments, confounded factorials, response surface methodology, change-over design, split-plot experiments and incomplete block designs. Examples will be used to illustrate application and analysis of these designs.

Mr. Monroe

## ST 541 (MA 541) THEORY OF PROBABILITY I

3 (3-0) F

(See mathematics, page 384.)

## ST 542 (MA 542) THEORY OF PROBABILITY II

3 (3-0) S

(See mathematics, page 384.)

## ST 552 BASIC THEORY OF LEAST SQUARES AND VARIANCE COMPONENTS

3 (2-2) F S

Prerequisites: MA 405, ST 521

Corequisite: ST 522

Theory of least squares; multiple regression; analysis of variance and covariance; experimental design models; factorial experiments; variance component models.

Staff

## ST 561 (EC 561) INTERMEDIATE ECONOMETRICS

3 (3-0) S

(See economics, page 300.)

## ST 571 (BMA 571, MA 571) BIOMATHEMATICS I

3 (3-0) F

(See biomathematics, page 263.)

## ST 572 (BMA 572, MA 572) BIOMATHEMATICS II

3 (3-0) S

(See biomathematics, page 263.)

## ST 581 INTRODUCTION TO NONPARAMETRIC STATISTICS

3 (3-0) F

Prerequisite: ST 522

This course will treat both theoretical and methodological material relevant to inference problems arising when sampling is from a parent family that is not assumed to have a particular functional form. Most of the course will be devoted to inference problems for the absolutely continuous family of distributions. (Offered fall 1974 and alternate years.)

Mr. Quesenberry

ST 583 INTRODUCTION TO STATISTICAL DECISION THEORY 3 (3-0) F  
Prerequisite: ST 522

The theory of statistical inference will be discussed from a unified decision theoretic point of view and its relationship with the zero-sum two person game will be studied. Detailed attention will be paid to the development of techniques of statistical analysis using Bayesian approach. The major emphasis in the course will be directed towards the solution of problems using decision theoretic concepts. (Offered fall 1973 and alternate years.) Mr. Bhattacharyya

ST 591 SPECIAL PROBLEMS 1-3 F S  
Development of techniques for specialized cases, particularly in connection with thesis and practical consulting problems. Staff

## FOR GRADUATES ONLY

ST 606 (MA 606, OR 606) MATHEMATICAL PROGRAMMING II	3 (3-0) S
ST 613 TIME SERIES ANALYSIS I	3 (3-0) S
ST 614 TIME SERIES ANALYSIS II	3 (3-0) F
ST 617, 618 (MA 617, 618) MEASURE THEORY AND ADVANCED PROBABILITY	3 (3-0) F S
ST 619 (MA 619) TOPICS IN ADVANCED PROBABILITY	3 (3-0) Sum.
ST 621 STATISTICS IN ANIMAL SCIENCE	3 (3-0) F
ST 622 (ANS 622) PRINCIPLES OF BIOLOGICAL ASSAYS	3 (3-0) S
ST 623 STATISTICS IN PLANT SCIENCE	3 (3-0) F
ST 626 (GN 626) STATISTICAL CONCEPTS IN GENETICS	3 (3-0) S
ST 631 THEORY OF SAMPLING APPLIED TO SURVEY DESIGN	3 (3-0) F
ST 637 ADVANCED STATISTICAL INFERENCE	3 (3-0) S
ST 651 (EC 651) ECONOMETRICS	3 (3-0) F
ST 652 (EC 652) TOPICS IN ECONOMETRICS	3 (3-0) S
ST 671 ADVANCED ANALYSIS OF VARIANCE AND VARIANCE COMPONENTS	3 (3-0) S
ST 672 SPECIAL ADVANCED TOPICS IN STATISTICAL ANALYSIS	3 (3-0) F
ST 674 ADVANCED TOPICS IN CONSTRUCTION AND ANALYSIS OF EXPERIMENTAL DESIGNS	3 (3-0) S
ST 682 STATISTICAL ANALYSIS FOR LINEAR MODELS	3 (3-0) F
ST 691 ADVANCED SPECIAL PROBLEMS	1-3 F S
ST 694 SEMINAR	1 (1-0) F S
ST 699 RESEARCH	Credits Arranged F S

# TEXTILE CHEMISTRY

## FOR UNDERGRADUATES

### TC 203 FIBER SCIENCE I

3 (3-0) F S

Prerequisite: CH 101

A lecture course emphasizing: the chemical constitution and properties of fiber-forming polymers; theories of fiber structure; the relationship between the molecular structure of linear polymers and physical properties of natural and man-made fibers; the principles and methods for producing man-made fibers; the chemical behavior of natural and man-made fibers.

Mr. Rutherford

### TC 301 TECHNOLOGY OF DYEING AND FINISHING

4 (3-2) F S

Prerequisite: TC 203, TX 250

A comprehensive course designed to familiarize the textile technology student with the basic principles involved and the procedures used for the preparation, dyeing, printing and finishing of natural and man-made fibers. Some emphasis is placed upon the chemical nature of dyes and fastness properties, and the chemical nature of finishes used to impart specific end-use properties.

Mr. Livengood

### TC 303, 304 TEXTILE CHEMISTRY I, II

303 2 (2-0) F S

304 2 (1-3) F S

Prerequisite: (303), sophomore standing; (304), TC 303

A systematic examination of the physical and chemical phenomena which occur in the preparation and finishing of textile materials. The emphasis will be on general principles, rather than on detailed technical procedures. TC 304 forms a natural continuation of this course.

Mr. McGregor

### TC 401 TEXTILE INDUSTRY AND THE ENVIRONMENT

3 (3-0) S

Prerequisite: Consent of instructor

Contents of the course include the concept of water quality management, criteria of pollution, sources of pollution from fabric processing, plant surveys and in-plant remedial measures, principles of biological oxidation, current waste-treatment practices, and new developments and trends in pollution control. While the emphasis is on wastes from the textile industry, the student is introduced to the broader aspects of environmental pollution.

Mr. Bryan

### TC 403, 404 TEXTILE CHEMICAL TECHNOLOGY

3 (3-0) F S

Prerequisites: (403) CH 223, TC 303

The chemistry involved in the wet processing of fibrous systems, especially dyeing, printing and finishing. The course emphasizes principles and includes a study of the various classes of dyes and their application to all important textile fibers and blends of fibers; preparatory and bleaching processes, roller printing and print formulations for important dye classes; nature and application of finishes for textiles.

Mr. Campbell

### TC 405, 406 TEXTILE CHEMICAL TECHNOLOGY LABORATORY

2 (0-6) F S

Prerequisites: TC 403, TC 404

Required of seniors in textile chemistry.

To be taken concurrently with TC 403, 404.

Mr. Campbell

### TC 411 TEXTILE CHEMICAL ANALYSIS I

3 (2-2) S

Prerequisite: TC 301

The course content includes a survey of textile chemicals, with emphasis on surfactants, warp sizes and fabric finishes of all types: the identification of fibers by chemical means; the qualitative and quantitative analysis of fiber blends by

chemical means, the identification of finishes, the evaluation techniques for dyed and finished materials. (Not available for students majoring in textile chemistry.)

Mr. Livengood

**TC 412 TEXTILE CHEMICAL ANALYSIS II**

3 (2-3) S

Prerequisite: CH 315

Application of certain techniques of analysis to fibers, textile chemicals and textile processes, ultraviolet, visible and infrared spectrophotometry; thin-layer and gas chromatography, viscometry; interfacial tension; calorimetric, gravimetric and mechanical thermal analyses. Emphasis on use of these techniques to solve problems of analysis involving such processes as sorption, solution, diffusion, crystallization, etc.

Mr. Cates

**TC 461 (CH 461) CHEMISTRY OF FIBERS**

3 (3-0) F

Prerequisite: CH 223

A lecture course emphasizing: the formation and properties of fiber-forming polymers; addition and condensation polymerization; theories of fiber structure, the relationship between the chemical structure and physical properties of natural and man-made fibers; the production of man-made fibers.

Mr. Gilbert

**TC 490 SPECIAL TOPICS IN TEXTILE CHEMISTRY**

1-6 F S

Special topics relating to current developments in textile and polymer chemistry.

Staff

**TC 491 SEMINAR IN TEXTILE CHEMISTRY**

1 (0-2) S

Prerequisite: TC 403

The course is designed to familiarize the student with the principal sources of textile chemical literature and to emphasize the importance of keeping abreast of developments in the field of textile chemistry. Particular attention is paid to the fundamentals of technical writing. Reports. Lectures arranged.

Messrs. Campbell, McGregor

**FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**TC 504 FIBER FORMATION-THEORY AND PRACTICE**

3 (3-0) F

Prerequisites: MA 301, PY 208 or consent of instructor

A practical and theoretical analysis of the chemical and physical principles underlying the conventional methods of converting bulk polymer to useful fiber; rheology; melt, dry and wet polymer extrusion; fiber drawing; heat setting; application of general theory to unit processes.

Mr. Cuculo

**TC 505 THEORY OF DYEING**

3 (3-0) S

Prerequisite: CH 433

Mechanisms of dyeing. Application of thermodynamics to dyeing systems. Kinetics of diffusion in dyeing processes.

Mr. McGregor

**TC 561 ORGANIC CHEMISTRY OF HIGH POLYMERS**

3 (3-0) S

Prerequisites: TC 461 (CH 461), CH 331 or CH 431

Principles of step- and chain-growth polymerizations; co-polymerization theory; homogeneous free radical polymerization; emulsion polymerization; Ziegler-Natta polymerization; ionic polymerization.

Messrs. Gilbert, Theil

**TC 562 (CH 562) PHYSICAL CHEMISTRY OF HIGH  
POLYMERS—BULK PROPERTIES**

3 (3-0) F

Prerequisites: CH 220 or CH 223; CH 331 or CH 431

Molecular weight description; states of aggregation and their interconversion; rubbery, glassy and crystalline states; rubber elasticity; molecular friction;

diffusion and viscosity; dynamics of network response; retardation- and relaxation-time spectra; thermodynamics of nucleation; kinetics of crystallization.

Messrs. Cates, Walsh

TC 569 (CHE 569)	POLYMERS, SURFACTANTS AND COLLOIDAL MATERIALS	3 (3-0) F
(See chemical engineering, page 271.)		

## FOR GRADUATES ONLY

TC 662	PHYSICAL CHEMISTRY OF HIGH POLYMERS—SOLUTION PROPERTIES	3 (3-0) S
TC 669 (CHE 669)	DIFFUSION IN POLYMERS	2 (2-0) S
TC 671 (CHE 671)	SPECIAL TOPICS IN POLYMER SCIENCE	1-3 F
TC 691 (TX 691)	SPECIAL TOPICS IN FIBER SCIENCE	1-3 S
TC 698	SEMINAR FOR TEXTILE CHEMISTRY	1 F S
TC 699	TEXTILE RESEARCH FOR TEXTILE CHEMISTRY	Credits Arranged

## TEXTILE TECHNOLOGY FOR UNDERGRADUATES

TX 211	FIBER SCIENCE II	3 (2-2) F S
Prerequisites: TC 203, MA 212 or 202		

A presentation of the physical properties of textile raw materials as related to type of fibers and chemical structure. Typical areas of discussion are parameters used to describe textile fibers, classification in terms of quality factors, their reactions to moisture, stress-strain properties, method of measuring physical properties covered in Fiber Science I, and relationship between polymer structure, fiber properties, and their utilization as single fiber composites or blends of fibers.

Messrs. Fornes, Hutchison

TX 220	YARN FORMING SYSTEMS	4 (3-2) F S
Prerequisite: T 101 or equivalent		

A study of the principles of staple and filament yarn systems and structures. The influence of the manufacturing system and the input materials on product characteristics is established.

Staff

TX 250	FABRIC FORMING SYSTEMS	4 (3-2) F S
Prerequisite: TX 220		

A study of the basic fabric forming systems, including nonconventional, weaving and knitting. Emphasis is on fabric construction and geometry. Structures of fabric and resulting properties are related to raw materials and product performance.

Staff

TX 320	DESIGN AND CONTROL OF STAPLE YARN SYSTEMS	5 (4-2) F S
Prerequisite: TX 220		
Corequisite: TX 211		

A discussion of the technological and economic aspects of staple yarn forming systems. Topics to be included are fiber-machine interactions, the use of automated systems and processes, the blending of similar and dissimilar textile fibers, and the

control of the overall manufacturing operation to yield products with designed characteristics. Messrs. Bradford, Lynch, Pardue

TX 330 TEXTILE MEASUREMENTS AND QUALITY CONTROL 4 (3-2) F S  
Prerequisites: TX 250, ST 361

Principles of measuring basic physical properties of textile materials, techniques of in-process control and evaluation of finished product quality; application to the manufacturing sequence, of statistical control charts and capability limits, aspects of sampling theory. Messrs. Hutchison, Stuckey

TX 340 PRINCIPLES OF KNITTED FABRIC STRUCTURES 5 (4-2) F S  
Prerequisites: TX 211, TX 250

Warp and weft knit fabrics, their properties, end uses and production as related to current trends and developments in fabrics and machines. The principles of design and fabric geometry as a basis for performance, quality, and costing. Finishing and its effect on fabric properties. Messrs. Brown, Middleton

TX 350 WOVEN FABRIC STRUCTURES 5 (4-2) F S  
Prerequisites: TX 211, TX 250

A study of performance characteristics of woven structures as related to properties of raw materials, fabric structure and methods of production. The utilization of modern control systems to optimize the systems involved in the production of woven fabrics. Messrs. Klibbe, Moser, Porter

TX 380 MANAGEMENT AND CONTROL OF TEXTILE SYSTEMS 3 (3-0) F S  
Prerequisites: EC 206, TX 250

The principles and techniques of controlling the process of converting staple fibers or filament yarns into industrial and consumer products as viewed from the standpoint of the process decision maker. Messrs. Cooper, Powell, Robinson

TX 405 NON-CONVENTIONAL FABRIC STRUCTURES 3 (3-0) F S  
Prerequisites: Senior standing and consent of instructor

An advanced study of systems for the direct conversion of fiber to fabrics. The total spectrum of possible fabric structure is surveyed and classified. Current marketable structures are analyzed with respect to production technologic, economic, and property potential. Trends in direct conversion technology are discussed in detail to provide the student with a viable basis for participating in the evolution of the technology and its production. Messrs. George, Porter

TX 420 MODERN DEVELOPMENTS IN YARN MANUFACTURING SYSTEMS 3 (3-0) S  
Prerequisite: Senior standing

A course dealing with the newly emerging means of yarn production such as open-end, compositer, self-twist and twistless forms of spinning. The course will deal with the preprocesses and their effects on spinning; also with the after-processes to assess the effects of the new systems. Mr. Lord

TX 425 CONTINUOUS FILAMENT YARN SYSTEMS 3 (2-2) F S  
Prerequisites: TX 211, TX 220

A study of the structure of thermoplastic polymers in continuous filament form and their response to elevated temperatures, high velocity air flow and other methods of modification to produce bulked, textured and torque type yarns. A fundamental study of related properties such as stress relaxation, generation and control of electrostatic charges and responses to low order tensile forces.

Mr. El-Shiekh

**TX 426 LONG STAPLE AND TOW SYSTEMS****3 (2-2) F S****Prerequisites:** TX 211, TX 220

Principles of long staple yarn forming systems including the woolen, worsted, tow to top, and compact carpet yarn systems. Emphasis is on the relationship of fiber structures and characteristics necessary to produce the desired properties and performance characteristics of such yarns as woolen and worsted blends with man-made fibers, bulked yarns and carpet yarns.

**Mr. Pardue****TX 431 SPECIAL TOPICS IN TESTING****3 (2-2) S****Prerequisites:** TX 330, senior or graduate standing

A topical presentation of special and advanced techniques for measuring selected physical and aesthetic properties of natural and man-made textile materials; application of the physical law to technique and instrumentation; interrelation of the material, method of test, instrumentation involved and the resulting physical measure.

**Mr. Stuckey****TX 441 ADVANCED WEFT KNITTING****3 (2-2) F****Prerequisite:** TX 340

A study of advanced weft knit mechanisms and fabrics. The development of new fabrics for specific end uses.

**Mr. Middleton****TX 447 ADVANCED DESIGN OF KNITTING STRUCTURES****2 (0-4) F S****Prerequisite:** TX 340

A study of the principles of design of knit structures and garments, needle selecting mechanisms, their scope and uses. Modern developments in selecting mechanisms. Economics of jacquard fabrics. Production scheduling. Quality control in jacquard knitting.

**Staff****TX 449 WARP KNITTING SYSTEMS****3 (2-2) S****Prerequisite:** TX 340

A critical study of tricot, raschel, simplex and milanese machines. The emphasis will be on principles of production including quality and costing, and the limitations of each method will be discussed. The fabric properties will be related to end uses, and both recent developments and future trends will be discussed in terms of improvements in yarns and mechanisms. Fabric design and analysis will receive attention.

**Staff****TX 450 ADVANCED DESIGN AND WEAVING****3 (2-2) F S****Prerequisite:** TX 350

Advanced study of special weave formations and of new developments and research findings in the areas of warp preparation, design weaving and fabric formation.

**Mr. Moser****TX 451 COMPLEX WOVEN STRUCTURES****3 (2-2) S****Prerequisite:** TX 450

The development of design specifications for complex fabrics as related to fabric geometry, functional and aesthetic properties and manufacturing limitations.

**Mr. Porter****TX 460 PHYSICAL PROPERTIES OF TEXTILE FIBERS****3 (3-0) F S****Prerequisites:** MA 212, PY 212

This course covers the structural, mechanical, thermal, optical, frictional and electrical properties, and the effect of moisture on physical and mechanical properties. The influence of these properties on the utility and the scope of the fibers as related to performance is studied.

**Messrs. Fornes, Gupta, Hersh**

**TX 465 MECHANICS OF YARN FORMATION****3 (2-2) F****Prerequisite:** TX 320

Theoretical analysis of machine-fiber interaction is studied for such functions as fiber blending, the carding actions, staple fiber attenuation, and spun yarn formation. Laboratory experiments are designed to verify the analyses discussed in the lecture.

**Mr. El-Shiekh****TX 470 FABRIC STYLING AND DESIGN****2 (2-0) F S****Prerequisite:** Junior or senior standing and consent of instructor

A basic course in textile styling and design as influenced by aesthetic and end-use considerations. The limitations and influence of current technology on design principles and aesthetic capabilities will be emphasized.

**Mrs. Massey****TX 480 TEXTILE COST CONTROL****3 (3-0) F S****Prerequisites:** TX 320, TX 350, EC 206

A study of cost methods applicable to textile costing with emphasis on decision-making. Interpretation of cost reports and their use in pricing and cost control.

**Messrs. Lynch, Powell****TX 482 (EC 482) SALES MANAGEMENT FOR TEXTILES****3 (3-0) S****Prerequisite:** TX 380

Definition and analysis of the role of sales management in the textile industry. Areas of control and responsibility are reviewed. Analytical tools of sales management are studied and through case methods are brought into practical focus for the student.

**Mr. Cooper****TX 484 MANAGEMENT DECISION MAKING FOR THE TEXTILE FIRM****3 (3-0) S****Prerequisite:** TX 482 (EC 482)

A study of the economic and environment setting within which the textile firm makes decisions, and an application of various analytical tools, quantitative and qualitative in making these decisions. Strategies for implementing these decisions are explored.

**Messrs. Cooper, Robinson****TX 490 DEVELOPMENT PROJECT IN TEXTILE TECHNOLOGY****2-3 F S****Prerequisites:** Senior standing, consent of instructor

Introduction to research through experimental, theoretical and literature studies of textile and related problems.

**Staff****TX 491 SPECIAL TOPICS IN TEXTILES****1-3 F S****Prerequisite:** Senior standing

Special topics relating to current developments in the textile industry.

**Staff****FOR GRADUATES AND ADVANCED UNDERGRADUATES****TX 530 TEXTILE QUALITY CONTROL****3 (3-0) S****Prerequisite:** TX 330 or consent of instructor

Quality control systems for textile operations with emphasis on sampling plans for attributes and variables and on interpretation of data as related to identifying sources of product variability.

**Mr. Stuckey****TX 550 FABRIC ANALYTICS****3 (3-0) F S****Prerequisite:** TX 350 or graduate standing

Development of a numerical system for characterizing designs. Permutations and combinations of weave elements. Correlation of fiber and yarn properties with those of the fabric. Engineering design of fabrics. Relationships between fabrics having geometrical similarity and the prediction of their physical properties.

**Mr. Bogdan**

**TX 560 STRUCTURAL AND PHYSICAL PROPERTIES OF FIBERS** 3 (3-0) F  
Prerequisite: MA 301

Advanced study of the structural and physical properties (including thermal, optical, frictional and electrical) of textile fibers. Theoretical relations and advanced techniques are presented and discussed.  
Mr. Gupta

**TX 561 MECHANICAL AND RHEOLOGICAL PROPERTIES OF FIBROUS MATERIAL** 3 (2-2) S  
Prerequisite: MA 301

In-depth study of the stress-strain, bending torsional dynamic and rheological behavior of natural and man-made fibers. Theoretical relations and advanced techniques are presented and discussed.  
Mr. Gupta

**TX 585 (EC 585) MARKET RESEARCH IN TEXTILES** 3 (3-0) S  
Prerequisites: MA 405, ST 421

A study and analysis of the quantitative methods employed in market research in the textile industry. The function of market research and its proper orientation to management and decision-making.  
Mr. Cooper

**TX 590 SPECIAL PROJECTS IN TEXTILES** 2-3 F S  
Prerequisites: Senior standing or graduate standing, consent of instructor

Special studies in either the major or minor field of the advanced undergraduate or graduate student. These studies will include current problems of the industry, independent investigations, seminars and technical presentation, both oral and written.  
Graduate Staff

**TX 591 SPECIAL TOPICS** 1-4 F S  
Prerequisite: Consent of instructor

An intensive treatment of selected topics involving textile technology.  
Graduate Staff

**TX 598 TEXTILE TECHNOLOGY SEMINAR** 2 (2-0) S  
Prerequisites: Senior standing, consent of instructor

Lecture and discussion of current topics relating to the textile industry.  
Graduate Staff

## FOR GRADUATES ONLY

**TX 601 STAPLE FIBER STRUCTURES I** 3 (2-2) F

**TX 602 STAPLE FIBER STRUCTURES II** 3 (2-2) F S

**TX 621 TEXTILE TESTING III** 2 (2-0) S

**TX 631 SYNTHETIC FIBERS** 2 (1-2) F S

**TX 641, 642 ADVANCED KNITTING SYSTEMS AND MECHANISMS** 3 (3-0) F S

**TX 643, 644 KNITTING TECHNOLOGY** 3 (1-4) F S

**TX 651, 652 FABRIC DEVELOPMENT AND CONSTRUCTION** 3 (1-4) F S

**TX 663 (MAE 663) MECHANICS OF TWISTED STRUCTURES** 3 (3-0) F

**TX 664 (MAE 664) MECHANICS OF FABRIC STRUCTURES** 3 (3-0) S

**TX 680 SPECIAL PROJECTS IN TEXTILE MANAGEMENT** 1-3 F S Sum.

TX 691 (TC 691) SPECIAL TOPICS IN FIBER SCIENCE	1-3 S
TX 698 SEMINAR	1 (1-0) F S
TX 699 TEXTILE RESEARCH	Credits Arranged

## TEXTILES

### General Courses

T 101 FUNDAMENTALS OF TEXTILES	2 (1-2) F
Prerequisite: None	

An introduction to textiles, including the history of the industry, description of textile materials and products and their utilization. Presentation of the basic manufacturing systems, materials flow, terminology and calculations.

Staff

T 300 GENERAL MICROSCOPY	3 (1-4) F
Prerequisite: PY 212	

The art and science of light microscopy and introduction to electron microscopy and microradiography; theoretical and practical aspects of visibility, resolution, and contrast. Laboratory practice in assembly, testing, and using various microscopes and accessories in describing, identifying, and photomicrographing crystalline, oriented, or amorphous materials which are used in the textile, fabric, plastic, and agricultural industries and in the life sciences.

Mr. Rochow

T 305 INTRODUCTION TO COLOR SCIENCE	1 (1-0) S
Prerequisite: Sophomore standing in School of Textiles or equivalent	

Brief discussion of color vision, defective color vision as it contributes to the understanding of color vision. Definition of color space and detailed discussion of the measurements and transformation of coordinates leading to the "CIE" color space. Color calculations, color differences and color matching.

Mr. Goldfinger

T 492 PROBLEMS IN SCIENCE AND TECHNOLOGY	1 (0-2) S
Prerequisite: Junior standing	

A series of lectures given by scientists and technologists from outside the University. The lectures to consist of the description of a scientific or technological problem, its analysis and its solution. The latter to be arrived at in cooperation with the class. The students write brief critical reviews of these lectures and discuss them in class. This course may be taken twice for a maximum of two credits.

Staff

### FOR GRADUATES AND ADVANCED UNDERGRADUATES

T 500 ADVANCED MICROSCOPY	3 (1-4) S
Prerequisite: T 300 or consent of the instructor	

The art and science of light and electron microscopy and introduction to microradiography; theoretical and practical aspects of visibility resolution and contrast. Laboratory practice in assembly, testing and using various microscopes and accessories in describing, identifying and micrographing crystalline, oriented, or amorphous materials, especially those which are of interest to the student. Laboratory work may include special projects for independent investigations.

Mr. Rochow

T 501 RESINOGRAPHY	3 (1-4) F S
Prerequisites: T 300 or T 500 and TX 460 or TX 560 or TC 461	

Lectures, laboratory and discussion regarding structure and morphology of resins, fibers, elastomers and composites. Such materials will be studied by reflected

light or electrons and by transmitted light or electrons. Other methods of diffraction and spectrometry will be discussed. Crystallographic and optical properties will be emphasized.

Mr. Rochow

**T 506 COLOR SCIENCE**

3 (2-2) F

Prerequisite: Senior in textile chemistry or graduate student

A thorough discussion of color theory with particular emphasis on color measurement. Color and color difference calculations.

From the data of the basic color matching experiments the description of a colorspace and its transformation into the CIE color space will be followed in detail.

The basis of color difference calculations will be discussed. Color matches and color differences will be calculated based on experimental data obtained in the course.

Mr. Goldfinger

## **TOXICOLOGY**

(See page 334.)

## **UNIVERSITY STUDIES**

### **FOR UNDERGRADUATES**

**UNI 301 SCIENCE AND CIVILIZATION**

3 (3-0) F S

Prerequisite: Sophomore standing

An examination of the emergence of a distinctively modern world-view in the West from the 13th to the 20th centuries. This course covers in some detail the scientific revolutions of the 17th to the 20th centuries in order to demonstrate the interrelatedness of scientific, social and aesthetic activity.

**UNI 302 SCIENCE AND CONTEMPORARY CIVILIZATION**

3 (3-0) F S

Prerequisite: Sophomore standing

This course explores the chief revolutionary developments in 20th century science and briefly traces some intellectual consequences of these developments. Areas of investigation include contemporary social theory, psychology, philosophy and theology.

**UNI 303 MAN AND HIS ENVIRONMENT**

3 (3-0) F S

Prerequisite: Sophomore standing

An examination of the growing interaction between man and his global environment. Attention will be directed to the fundamental concepts of ecology, the impacts of technology upon the contemporary world environment, the broad, humanistic aspects of our present environmental problems and the need for new institutional arrangements in both government and the university as an aid to their solution.

**UNI 323 THE WORLD POPULATION AND FOOD CRISIS**

3 (2-1) S

Prerequisite: Sophomore standing

An inter-disciplinary analysis of United States and world population growth in connection with national and world food requirements and man's place in the ecology of the earth. Attention will be given to the complex issues of population growth in both developed and developing nations in light of United States policies and programs. Controversial proposals will be discussed and evaluated. Two lectures and one discussion section each week.

**UNI 401 THE URBAN CRISIS**

3 (2-1) F

A discussion of domestic urban issues, particularly those which have resulted from the impact of technology. The course examines the change from a rural to an urban society, and considers such resulting problems as poverty in affluence, racial

tensions and changes in the environment. Controversial proposals will be discussed. Course materials may include newspapers as well as texts.

#### UNI 402 THE ARMS RACE

3 (2-1) S

A discussion of international issues facing the United States, particularly those which reflect the impact of the new technology. This course begins with an examination of the revolution of modern weaponry, and moves on to a discussion of the cold war and the consequences of the world arms race for the underdeveloped as well as the industrialized world. Selected areas of current interest will be examined in the light of the framework developed. Controversial positions will be discussed in lecture and section meetings. Course materials include current newspapers as well as texts.

#### UNI 490 SEMINAR IN UNIVERSITY STUDIES

1-3

Investigation and discussion of selected topics of an interdisciplinary nature. Topics selected vary to meet interest of students and fields of competence of instructors.  
Mr. Carnesale

#### UNI 495 SPECIAL TOPICS IN UNIVERSITY STUDIES

1-3

Staff

## URBAN DESIGN

#### UD 501 INTRODUCTORY PROBLEMS IN URBAN DESIGN

3 (0-6) F

Prerequisite: Graduate standing

Introduction to descriptive analysis of physical and socio-economic phenomena of urban environments, and application of research methods in the definition and resolution of urban design problems.  
Mr. Batchelor

#### UD 502 URBAN DESIGN WORKSHOP I

3 (0-6) S

Prerequisite: UD 501

Complete synthesis of design factors influencing an environmental system or an urban complex.  
Mr. Batchelor

#### UD 520 THEORY AND PRINCIPLES OF URBAN DESIGN

3 (3-0) S

Prerequisite: Graduate standing

An examination of the nature of the design process in urban environments with special emphasis on contemporary theory and practice.  
Staff

#### UD 590 SPECIAL TOPICS IN URBAN DESIGN I

1-6 F S

Prerequisite: Fourth year standing

This course provides a flexible means for investigation into areas of special interest related to urban design. It is intended primarily to encourage independent study and research.  
Staff

#### UD 595 ENVIRONMENTAL PERCEPTION

3 (3-0) S

Prerequisite: Graduate standing

The course is designed to acquaint the student with the theories and research on the perception of urban environments. Emphasis is placed on the visual attributes as well as user perceptions of the environment with a focus on the structuring of research to explore these dimensions.  
Staff

## FOR GRADUATES ONLY

#### UD 601 URBAN DESIGN WORKSHOP II

6 (0-12) F

#### UD 602 ADVANCED PROBLEMS IN URBAN DESIGN

6 (0-12) S

## WOOD AND PAPER SCIENCE

### FOR UNDERGRADUATES

WPS 101 (FOR 101) INTRODUCTION TO FOREST RESOURCES 1 (1-0) F  
(See forestry, page 336.)

WPS 201 WOOD STRUCTURE AND PROPERTIES 3 (2-3) S

Identification, structure, properties and uses of woods of economic importance in the United States. This course is a condensation of WPS 202, WPS 203 with less emphasis.  
Mr. Carter

WPS 202 WOOD STRUCTURE AND PROPERTIES I 3 (2-3) F  
Prerequisite: BS 100 or BO 200

The macrostructure and microstructure of wood is emphasized in this introductory course. As related to wood structure, the physical properties and uses of several commercially important coniferous and deciduous woods are also studied. The techniques of hand lens and microscope identification of wood are covered.  
Mr. Thomas

WPS 203 WOOD STRUCTURE AND PROPERTIES II 3 (2-3) S  
Prerequisites: WPS 202, PY 221 or PY 211

Physical properties of wood, specific gravity relationships, wood in relation to moisture, wood in relation to heat, sound, light, electricity, combustion; introduction to strength properties of wood.  
Mr. Hart

WPS 205 WOOD MACHINING PRACTICUM 1 Sum.

Prerequisite: WPS 201 or WPS 202

Sophomore Summer Practicum

Laboratory exercises in machining of wood.

Staff

WPS 206 WOOD DRYING PRACTICUM 1 Sum.

Prerequisite: WPS 201 or WPS 202

Sophomore Summer Practicum

Laboratory exercises in wood drying.

Staff

WPS 207 GLUING PRACTICUM 1 Sum.

Prerequisite: WPS 201 or WPS 202

Sophomore Summer Practicum

Laboratory exercises in gluing wood and preparation of particle board.

Staff

WPS 208 WOOD FINISHING PRACTICUM 1 Sum.

Prerequisite: WPS 201 or WPS 202

Sophomore Summer Practicum

Laboratory exercises in wood finishing.

Staff

WPS 209 PLANT INSPECTIONS 1 Sum.

Prerequisite: WPS 201 or WPS 202

Sophomore Summer Practicum

Inspection of wood-using plants.

Staff

- WPS 210 FOREST PRODUCTIONS INTERNSHIP** 1 Sum.  
 Prerequisite: Completion of summer practicum  
 This course provides experience in the forest products or related industries under a program through which the student is assigned problem solving in an industrial situation to provide him with some insight of forest products technology. Students are expected to write a paper on their experience. Mr. Carter
- WPS 211 PULP AND PAPER INTERNSHIP** 1 (1-0) F  
 Prerequisite: Completion of sophomore year  
 This course provides experience in the pulp and paper industry under a program through which the student is assigned problem solving in an industrial setting to provide him with some insight of pulp and paper technology. Students are expected to write a paper on their experience. Staff
- WPS 219 (FOR 219) FOREST ECONOMY AND ITS OPERATION** 3 (2-2) F  
 (See forestry, page 337.)
- WPS 242 FIBER ANALYSIS** 3 (1-4)  
 Fiber microscopy; the determination of fiber measurement, quality, variation and identity in pulpwood. Staff
- WPS 273 (FOR 273) QUANTITATIVE METHODS IN FOREST RESOURCES** 3 (2-2) F S  
 (See forestry, page 337.)
- WPS 301 WOOD PROCESSING I** 3 (2-2) F  
 Prerequisites: WPS 201 or WPS 202 and summer practicum  
 The processes of drying, gluing and finishing wood. Processes of reconstituting wood as fiberboard, hardboard and particle board. Basic requirements of various procedures and materials. Factors in selecting production methods. Mr. Carter
- WPS 302 WOOD PROCESSING II** 3 (2-3) S  
 Prerequisites: WPS 201 or WPS 203  
 The theories and techniques of converting raw wood into usable products by milling, veneering and chipping round wood. Included also is the processing of finished lumber, dimension stock, plywood and other wood products. Mr. Carter
- WPS 319 (PP 319) BIOLOGICAL DETERIORATION OF WOOD** \*1 (2-3) S  
 (See plant pathology, page 426.)  
 \*Students attend course for five weeks.
- WPS 320 WOOD PRODUCTS CHEMISTRY** 3 (2-3) F  
 Prerequisite: CH 103  
 A general description of the chemical and physico-chemical properties of wood followed by an introduction to the chemical principles of the processes involved in wood products industries including pulp manufacture for paper and fiber board, wood adhesion and lamination, wood finishing, wood preservation, wood drying and dimensional stabilization. Mr. Chang
- WPS 321, 322 PULP AND PAPER TECHNOLOGY** 3 (3-0) F S  
 Brief survey of the physical and chemical characteristics of wood and cellulose. Chemistry and technology of the major mechanical, chemical and semichemical processes employed in the manufacture of pulp and paper. Mr. Hitchings
- WPS 331 INTRODUCTION TO WOOD AND PULPING CHEMISTRY** 1 (1-0) F  
 Prerequisite: CH 220  
 Topics in organic chemistry required for a basic understanding of wood and

pulping chemistry. Special emphasis will be placed on carbonyl groups and aliphatic and phenolic hydroxyl groups as well as stereochemistry. Mr. Gratzl

**WPS 332 WOOD AND PULPING CHEMISTRY**

4 (3-3) S

Prerequisites: CH 220, WPS 331 or CH 221-223

The role of wood as a basic source for fibers and chemicals. Major wood components including cellulose, hemicelluloses, lignin and extractives. Special emphasis will be placed on the reactions of wood components in the major pulping and bleaching processes. Mr. Gratzl

**WPS 344 INTRODUCTION TO QUALITY CONTROL**

3 (2-1) S

Prerequisite: ST 361

A study of methods used to control quality of manufactured wood products. Control charts of variables and attributes. Acceptance sampling techniques. Staff

**WPS 403 PAPER PROCESS ANALYSIS**

3 (0-6) S

Manufacture of several types of papers with particular attention to stock preparation, sizing, filling and coloring. The finished products are tested physically and chemically and evaluated from the standpoint of quality and in comparison with the commercial products they are intended to duplicate. Mr. Hitchings

**WPS 411, 412 PULP AND PAPER UNIT PROCESSES**

3 (3-0) F S

Principles of operation, construction and design of process equipment employed in the pulp and paper industry. Mr. Rogers

**WPS 413 PAPER PROPERTIES AND ADDITIVES**

3 (1-6) F

Physical, chemical and microscopical examination of experimental and commercial papers and evaluation of the results in terms of the utility of the product tested; evaluation and identification of dyestuffs and the development of color formulas. Mr. Reeves

**WPS 423 (FOR 423) LOGGING AND MILLING**

3 (2-3) F

Analysis of timber harvesting and transportation systems, equipment selection and costs; safety and supervision; manufacturing methods; log and lumber grades; analysis of investment alternatives. Mr. Mullin

**WPS 434 WOOD OPERATIONS I**

3 (2-3) F

Prerequisites: WPS 301, WPS 302

Organization of manufacturing plants producing wood products, including company organization, plant layout, production planning and control. Analysis of typical manufacturing operations in terms of processes, equipment, size and product specification. The organization and operation of wood products markets. Mr. Carter

**WPS 435 (FOR 435) SYSTEMS ANALYSIS IN FOREST PRODUCTS**

3 (3-0) S

Prerequisite: Senior standing

The application of the techniques of operations analysis to management decision-making in the wood products field. Allocation of production resources, inventory of raw materials, scheduling of production activities and general problems of quantitative decision-making. Mr. Hafley

**WPS 441 INTRODUCTION TO WOOD MECHANICS**

2 (2-0) F

Prerequisites: MA 212, PY 221 or PY 211

Strength and related properties of commercial woods; standard ASTM strength tests; toughness; timber fastening; design of columns; simple, laminated and box beams; trusses and arches. Mr. Pearson

**WPS 442 WOOD MECHANICS AND DESIGN****3 (2-3) S****Prerequisite:** EM 211 or WPS 441

The course will provide an understanding of wood as an engineering material. Topics include—generalized Hooke's law for orthotropic bodies and the effect of orientation of applied forces relative to the axes of symmetry; mechanical properties of wood as affected by its cellular structure; influence of defects, moisture, temperature and duration of load; visual and mechanical grading; derivation of working stresses; glued laminated construction; structural plywood; design of wooden members.

**Mr. Pearson****WPS 461 PAPER CONVERTING****1 (1-0) S**

A survey of the principal processes by which paper and paper board are fabricated into the utilitarian products of everyday use.

**Mr. Reeves****WPS 463 PLANT INSPECTIONS****1 (0-3) S**

One-week inspection trips covering representative manufacturers of pulp and paper and paper-making equipment.

**Staff****WPS 471 PULPING PROCESS ANALYSIS****3 (1-6) F**

Preparation and evaluation of the several types of wood pulp. The influence of the various pulping and bleaching variables on pulp quality are studied experimentally and these data evaluated critically.

**Mr. Hitchings****WPS 481 PULPING PROCESSES AND PRODUCTS****2 (2-0) S****Prerequisites:** WPS 202, CH 103

Technology and economics of pulp products and by-products, including: paper and paperboard, containers and boxes, structural boards, molded and laminated products, cellulose fibers and films, cellulose derivatives and silvichemicals.

**Mr. Reeves****WPS 491 (FOR 491) SENIOR PROBLEMS IN FOREST RESOURCES Credits Arranged****Prerequisite:** Consent of department

Problems selected with faculty approval in the areas of management or technology.

**Staff****WPS 492 (FOR 492) SENIOR PROBLEMS IN FOREST RESOURCES Credits Arranged****Prerequisite:** Consent of department

Problems selected with faculty approval in the areas of management or technology.

**Staff****FOR GRADUATES AND ADVANCED UNDERGRADUATES****WPS 513 TROPICAL WOODS****2 (1-3) F****Prerequisites:** WPS 203, WPS 301

Structure, identification, properties, characteristics and use of tropical woods, especially those used in plywood and furniture.

**Staff****WPS 521, 522 CHEMISTRY OF WOOD AND WOOD PRODUCTS****3 (2-3) F S****Prerequisites:** CH 315, CH 331, WPS 202, PY 212

Fundamental chemistry and physics of wood and wood components; pulping principles; electrical and thermal properties.

**Mr. Gratzl****WPS 525 POLLUTION ABATEMENT IN FOREST PRODUCTS INDUSTRIES****3 (3-0) S****Prerequisite:** Graduate or advanced undergraduate standing in science or engineering curricula

The course will deal with pollution sources, inplant control and treatment of

water and air pollution in forest products. In the main, the course will concentrate upon inplant pollution control in the pulp and paper industry. Mr. McKean

WPS 533 ADVANCED WOOD STRUCTURE AND IDENTIFICATION 2 (1-3) F

Prerequisite: WPS 202

Advanced microscopic identification of the commercial woods of the United States and some tropical woods; microscopic anatomical features and laboratory techniques. Staff

WPS 591 WOOD AND PAPER SCIENCE PROBLEMS Credits Arranged

Prerequisite: Senior or graduate standing

Assigned or selected problems in the field of logging, lumber manufacturing, or pulp technology. Staff

WPS 599 (FOR 599) METHODS OF RESEARCH IN WOOD AND PAPER SCIENCE Credits Arranged

Prerequisite: Senior or graduate standing

Research procedures, problem outlines, presentation of results; consideration of selected studies by forest research organizations; sample plot techniques. Staff

## FOR GRADUATES ONLY

WPS 604 TIMBER PHYSICS 3 (3-0) F S

WPS 605 DESIGN AND CONTROL OF WOOD PROCESSES 3 (3-0) F S

WPS 606 WOOD PROCESS ANALYSIS 3 (3-0) F

WPS 607 ADVANCED QUALITY CONTROL 3 (3-0) S

WPS 691 (FOR 691) GRADUATE SEMINAR 1 (1-0) F S

WPS 693 ADVANCED WOOD TECHNOLOGY PROBLEMS Credits Arranged

WPS 699 PROBLEMS AND RESEARCH Credits Arranged

## ZOOLOGY

### FOR UNDERGRADUATES

BS 100 GENERAL BIOLOGY 4 (3-3) F S  
(See biological sciences, page 262.)

ZO 201 ANIMAL LIFE 4 (3-3) F S  
Prerequisite: BS 100 or BS 105

The biology of the major groups of animals, with emphasis on general structural plans and diversity, reproduction, development, ecology, behavior and evolution.  
Mr. Martof, Mrs. Bradbury

ZO 221 CONSERVATION OF NATURAL RESOURCES 3 (3-0) F S  
Prerequisite: BS 100

The importance of natural resources to man and the part they play in his environment. The physical, biological and ecological principles underlying natural resource conservation with particular attention given to the biological consequences of overexploitation and environmental pollution. Mr. Barkalow

- ZO 223 COMPARATIVE ANATOMY 4 (2-4) F S  
Prerequisite: ZO 201 or consent of instructor  
A comparative morphology of vertebrates demonstrating the interrelationships of the organ systems of the various groups. Mr. Harkema
- ZO 315 GENERAL PARASITOLOGY 3 (2-3) S  
Prerequisite: ZO 201  
The course is designed to give students a knowledge and appreciation of the life history, pathology and control of some common parasites. Messrs. Harkema, Miller
- ZO 345 HISTOLOGY 4 (2-4) F  
Prerequisite: ZO 223 or ZO 351  
The microscopic anatomy of animal tissues. Mr. Harkema
- ZO 350 INVERTEBRATE ZOOLOGY 4 (2-6) S  
Prerequisite: ZO 201  
The biology and classification of the invertebrate animals with special reference to types commonly encountered and to those that illustrate zoological principles. Mrs. Bradbury
- ZO 351 VERTEBRATE ZOOLOGY 4 (3-3) S  
Prerequisite: ZO 201  
The biology of the vertebrates: their adaptations and evolutionary history. Comparative physiological, developmental, behavioral and anatomical studies. Mr. Martof
- ZO 353 WILDLIFE MANAGEMENT 3 (3-0) F  
Prerequisite: BS 100  
The course describes the historical development from empirical practices to the scientific American system. Then, the principles of management, protection, and conservation of those warm blooded vertebrates of aesthetic, sport or food values in urban, rural and wilderness areas are considered. Mr. Barkalow
- ZO 360 (BO 360) INTRODUCTION TO ECOLOGY 4 (3-3) F S  
(See botany, page 264.)
- ZO 361 VERTEBRATE EMBRYOLOGY 4 (3-3) S  
Prerequisite: ZO 223 or ZO 351  
The study of fundamental principles that apply to the embryonic development of vertebrates. Mr. Roberts
- ZO 400 BIOLOGICAL BASIS OF MAN'S ENVIRONMENT 3 (2-2)  
Prerequisite: Junior standing  
A description of man's impact on the environment and the biological laws that govern the consequences in terms of population growth, pollution, and ecology.
- ZO 401 (ENT 401) BIBLIOGRAPHIC RESEARCH IN BIOLOGY 1 (1-0) F  
(See entomology, page 330.)
- ZO 414 (BO 414) CELL BIOLOGY 3 (3-0) F  
Prerequisites: CH 223, PY 212, ZO 20.  
A study of the chemical and physical bases of cellular structure and function with emphasis on methods and interpretations. Mr. Roberts
- ZO 415 CELLULAR AND ANIMAL PHYSIOLOGY LABORATORY 2 (0-5) S  
Corequisites: ZO 414 or ZO 421

An introduction to physiological techniques and experimentation. Laboratory experiments include studies of cells and examination of the functions of vertebrate organ systems. Mr. Smith

**ZO 420 FISHERY SCIENCE**

3 (2-3) F

Prerequisites: ZO 201, ZO 360

The science of fishery biology: life history and biology of important game and commercial fishes, fishing methods, age and growth analysis, survey of fishery resources, tagging studies, population estimations and pollution studies.

Messrs. Hassler, Huish

**ZO 421 VERTEBRATE PHYSIOLOGY**

3 (3-0) F S

Prerequisites: CH 223, PY 212, ZO 201

Physiology of vertebrates with emphasis on mammals. A comprehensive study of the mechanisms that operate to sustain life.

Mr. Smith

**ZO 441 ICHTHYOLOGY**

3 (2-3) S

Prerequisites: ZO 223 or ZO 351

The classification and ecology of selected groups of fishes. Lectures, laboratories and field trips dealing with systematics, life histories, interrelationships and distribution.

Mr. Hassler

**ZO 490 SPECIAL TOPICS IN ZOOLOGY**

3 (2-1)

Prerequisite: Junior standing

## **SPECIALIZED COURSES**

**ZO 212 BASIC ANATOMY AND PHYSIOLOGY**

4 (3-3) F

Prerequisite: BS 100 (Only free elective credit will be allowed for students majoring in biological sciences, zoology, conservation and wildlife biology.)

A study of anatomy and physiology with major emphasis on the structure and function of the muscular, skeletal, circulatory and nervous systems.

Mr. Miller

## **FOR GRADUATES AND ADVANCED UNDERGRADUATES**

**ZO 501 ORNITHOLOGY**

3 (2-3) F

Prerequisites: ZO 223 or ZO 351, ZO 421

The biology of birds: systematics, physiology, life histories, ecology and behavior.

Mr. Quay

**ZO 503 (PSY 503) COMPARATIVE PSYCHOLOGY**

3 (3-0) S

(See psychology, page 442.)

**ZO 510 ADAPTIVE BEHAVIOR OF ANIMALS**

4 (3-3) F

Prerequisite: ZO 421 or consent of instructor

The comparative study of animal behavior including a treatment of physiological mechanisms and adaptive significance. Both invertebrates and vertebrates are studied.

Mr. Whitsett

**ZO 513 (PHY 513) COMPARATIVE PHYSIOLOGY**

4 (3-3) F

Prerequisites: ZO 421 or consent of instructor

A comparative study of the organ systems of vertebrates and invertebrates and the physiological processes involved in maintaining the homeostatic state. The various compensatory mechanisms employed during environmental stress are included.

Mr. Lee

- ZO 515 GROWTH AND REPRODUCTION OF FISHES** 3 (2-3) S  
Prerequisites or corequisites: GN 411, ZO 420, ZO 421, ZO 441  
The biology of fishes: physiology, anatomy, pathology, behavior and genetics. This course is designed especially for graduate students in fisheries. Several trips to research laboratories are taken. (Offered in spring 1973 and alternate years.)  
Mr. Pardue
- ZO 517 POPULATION ECOLOGY** 3 (3-0) S  
Prerequisites: ZO 360 and ST 511 or equivalent  
The dynamics of natural populations. Current work, theories and problems dealing with population growth, fluctuation, limitation and patterns of dispersion, the ecological niche, food chains and energy flow. Emphasis on methods of study.  
Mr. Hayne
- ZO 519 LIMNOLOGY** 4 (3-3) F  
Prerequisite: ZO 360 or equivalent  
A study of inland waters. Lectures dealing with physical, chemical and biological factors that affect freshwater organisms. General principles are illustrated in the laboratory and on field trips.  
Mr. Hobbie
- ZO 524 (PO 524) COMPARATIVE ENDOCRINOLOGY** 4 (3-3) S  
(See poultry science, page 437.)
- ZO 529 (MAS 529) BIOLOGICAL OCEANOGRAPHY** 3 (3-0) S  
Prerequisite: ZO 360 or consent of instructor  
A comprehensive course stressing the dynamic interrelationships between organisms of the sea and their physical and chemical environment. The latter part of the course will examine fundamental concepts in biological oceanography and will particularly stress experimental methods.  
Mr. Copeland
- ZO 532 (GN 532) BIOLOGICAL EFFECTS OF RADIATIONS** 3 (3-0) S  
(See genetics, page 341.)
- ZO 540 (GN 540) EVOLUTION** 3 (3-0) F  
(See genetics, page 341.)
- ZO 542 HERPETOLOGY** 3 (2-3) S  
Prerequisites: ZO 223 or ZO 351, ZO 421  
The biology of the amphibians and reptiles: systematics, life history, anatomy, behavior, physiology and ecology.  
Mr. Martof
- ZO 544 MAMMALOLOGY** 3 (2-3) S  
Prerequisites: ZO 223 or ZO 351, consent of instructor  
The classification, identification and ecology of the major groups of mammals.  
Mr. Barkalow
- ZO 550 (GN 550) EXPERIMENTAL EVOLUTION** 3 (3-0) F  
(See genetics, page 342.)
- ZO 553 PRINCIPLES OF WILDLIFE SCIENCE** 3 (2-3) F  
Prerequisites: ZO 360  
The principles of wildlife management and their application are studied in the laboratory and in the field.  
Mr. Davis
- ZO 555 (MB 555) PROTOZOOLOGY** 4 (2-6) F  
Prerequisite: Consent of instructor  
The biology of the Protozoa: lectures include morphology, physiology, ecology,

genetics, reproduction, evolution, systematics and life-cycles of both free-living and parasitic taxa; laboratory will stress recognition of selected forms and demonstrate techniques used to prepare specimens for microscopic examination.

Mrs. Bradbury

ZO 560 (BO 560) PRINCIPLES OF ECOLOGY 4 (3-3) F  
Prerequisite: Three semesters of college-level biology courses

A consideration of the principles of ecology at the graduate level. Each of the major subject areas of ecology is developed in sufficient depth to provide a factual and philosophical framework for the understanding of ecology. Staff

ZO 575 (PHY 575, ENT 575) PHYSIOLOGY OF INVERTEBRATES 3 (3-0) S  
Prerequisite: ZO 350 or consent of instructor

The course will deal with physiology of invertebrates including the insects but excluding the Protozoa. The unity of the physiology of the various groups will be stressed. Mr. Wolcott

ZO 581 HELMINTHOLOGY 4 (2-4) F  
Prerequisites: ZO 223 or ZO 351, ZO 315 or equivalent

The study of the morphology, biology and control of the parasitic helminths.

Mr. Miller

ZO 582 (ENT 582) MEDICAL AND VETERINARY ENTOMOLOGY 3 (2-3) S  
(See entomology, page 332.)

ZO 590 SPECIAL STUDIES Credits Arranged  
Prerequisites: Twelve semester credits in zoology, consent of instructor

A directed individual investigation of a particular problem in zoology, accompanied by a review of the pertinent literature. Staff

ZO 592 TOPICAL PROBLEMS 1-3  
Prerequisite: Consent of instructor

Organized, formal lectures and discussions of a special topic.

Staff

## FOR GRADUATES ONLY

ZO 603 ADVANCED PARASITOLOGY 3 (2-3) S

ZO 610 CURRENT ASPECTS OF ANIMAL BEHAVIOR 4 (3-3) F

ZO 614 ADVANCED CELL BIOLOGY 3 (3-0) S

ZO 615 ADVANCED CELL BIOLOGY LABORATORY 1 (0-3) S

ZO 619 ADVANCED LIMNOLOGY 3 (1-6) S

ZO 621 FISHERY SCIENCE 3 (2-3) F

ZO 660 (BO 660) ADVANCED TOPICS IN ECOLOGY I 4 (3-3) S

ZO 661 (BO 661) ADVANCED TOPICS IN ECOLOGY II 4 (3-3) S

ZO 690 SEMINAR 1 (1-0) F S

ZO 699 RESEARCH IN ZOOLOGY Credits Arranged

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- JAMES BRYANT KIRKLAND  
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*Assistant Professor Emeritus in Textile Research.* Lowell Textile Institute

# The Alumni Association

BRYCE R. YOUNTS, *Director of Alumni Affairs*

The Office of Alumni Affairs maintains direct contact between North Carolina State University and her alumni. The Alumni Association has been organized for the purpose of promoting the growth, progress and general welfare of the University: to foster among its students and former students a sentiment of regard for one another and a continuing attachment to their Alma Mater; and to interest prospective students in enrolling at North Carolina State University.

## ASSOCIATION MEMBERSHIP

Active membership is available to all former students, regardless of length of stay at the University; members of the faculty, administrative staff, Agricultural Extension Service, Agricultural Experiment Station, teachers of agriculture in North Carolina high schools and all persons who have successfully completed a short course at North Carolina State University. Honorary membership in the association may be conferred on those distinguished persons as are duly elected.

The association meets annually during Alumni Weekend. Class reunions, scheduled for each class at five-year intervals following graduation, are also held each year in connection with Alumni Weekend. Officers of the association are elected annually by the active membership by mail ballot. Local alumni clubs are organized in most of the counties in North Carolina and in a number of cities in other states.

## THE ALUMNI LOYALTY FUND

The Alumni Loyalty Fund was established by the association in 1952 to replace the dues-paying program then in effect. This fund provides a means through which alumni may contribute to the progress of North Carolina State University. Every alumnus is invited to make a voluntary annual contribution.

## NCSU ALUMNI NEWS

This is the official publication of the Alumni Association and is published bimonthly. Its purpose is to enable members to keep in touch with each other and with the University. All alumni fund contributors receive the *Alumni News* on a regular basis. Included in the magazine are news and pictures of the University, its students, faculty and alumni as well as articles of a general nature dealing with timely subjects in the field of higher education.

## THE ALUMNI OFFICE

The Office of Alumni Affairs is located in the Alumni Memorial Building on the eastern edge of the campus. It serves as headquarters for visiting alumni and houses records of all alumni, both graduates and nongraduates. The files include individual biographical information, mailing lists by classes and geographical areas and certain other specific data.

Constant effort is made to facilitate an exchange of ideas and suggestions among the alumni, students and the University. The Office of Alumni Affairs serves as the focal point through which this objective is accomplished. Activities involving alumni, students and faculty members are included in the program of

the Association in an effort to foster a closer relationship between all groups so important in the life of the University.

## **Foundations And Development**

**RUDOLPH PATE**, *Director*

The Office of Foundations and Development is the principal private fund raising and public affairs division of the University. It embraces the work of ten incorporated foundations, alumni affairs, news services, University publications and general public relations activities. It is concerned with all programs of public affairs and interpretation of the University in the public context.

The foundations include the North Carolina State University Foundation, Inc., the North Carolina Agricultural Foundation, Inc., the North Carolina Dairy Foundation, Inc., the North Carolina State University Education Foundation, Inc., the North Carolina Engineering Foundation, Inc., the North Carolina Textile Foundation, Inc., the North Carolina Design Foundation, Inc., the North Carolina Forestry Foundation, the Pulp and Paper Foundation, Inc., and the North Carolina 4-H Development Fund, Inc.

### **NORTH CAROLINA STATE UNIVERSITY FOUNDATION**

The North Carolina State University Foundation, Inc., was organized December 11, 1942, to foster and promote the general welfare of North Carolina State University and to receive and administer gifts and donations for such purposes.

### **AGRICULTURAL FOUNDATION**

The North Carolina Agricultural Foundation, Inc., renders financial assistance in the development of strong teaching, research and extension programs in agriculture through the School of Agriculture and Life Sciences at North Carolina State University.

### **NORTH CAROLINA STATE UNIVERSITY EDUCATION FOUNDATION, INC.**

The North Carolina State University Education Foundation, Inc., was chartered on October 20, 1972. The Foundation's principal purpose is to support through private funds the teaching, research, and extension programs of the School of Education at North Carolina State University.

### **DAIRY FOUNDATION**

The North Carolina Dairy Foundation, Inc., aims to promote and improve all phases of dairying in North Carolina through education, research and extension. A 48-member board of directors handles the affairs of the foundation. These directors represent distributors, producers and jobbers.

### **ENGINEERING FOUNDATION**

The North Carolina Engineering Foundation, Inc., gives financial assistance to the programs in the Schools of Engineering and Physical and Mathematical Sciences.

## **TEXTILE FOUNDATION**

The North Carolina Textile Foundation, Inc., was formed to promote the development of the School of Textiles, and was incorporated December 31, 1942. Funds for this foundation have been raised largely from textile manufacturing plants, other corporations and industries closely allied with textiles.

## **DESIGN FOUNDATION**

The North Carolina Design Foundation, Inc., was organized in January, 1949. Foundation funds are used for the promotion and advancement of the School of Design at North Carolina State University.

## **FORESTRY FOUNDATION**

The North Carolina Forestry Foundation was incorporated April 15, 1929. The Foundation has acquired a tract of land known as the Hofmann Forest, consisting of about 80,000 acres in Jones and Onslow counties, which is used as a demonstration and research laboratory for the School of Forest Resources at North Carolina State University.

## **PULP AND PAPER FOUNDATION**

The Pulp and Paper Foundation, Inc., was incorporated December 19, 1954, by the Southern pulp and paper mills for the purpose of supporting the program of pulp and paper technology in the School of Forest Resources.

## **4-H DEVELOPMENT FUND**

The North Carolina 4-H Development Fund, Inc., was organized in 1959. Four-H Development Fund monies are used to promote and advance all areas of 4-H Club work in North Carolina.

# **University Disruptions Policy and Procedures**

*A thorough and conscientious effort, which involved University trustees, administrative officers, faculty members, and student representatives, has been made to improve and clarify the University's policies and procedures for dealing with disruptive conduct. Basic to this endeavor has been the goal of preserving the right of all individuals to engage in peaceful dissent while proscribing conduct intended to obstruct or disrupt the normal operations of the University. It is sincerely believed and earnestly hoped that the results will prove to be fair and equitable to all concerned.*

*This policy was adopted by the duly constituted governing authorities as a part of the Code of the University of North Carolina, which now embraces all four-year senior public institutions in North Carolina, and has the full effect of law.*

## **POLICIES, PROCEDURES, AND DISCIPLINARY ACTIONS IN CASES OF DISRUPTION OF EDUCATIONAL PROCESS**

### **Section 5-1. Policies Relating to Disruptive Conduct**

The University of North Carolina has long honored the right of free dis-

cussion and expression, peaceful picketing and demonstrations, the right to petition and peaceably to assemble. That these rights are a part of the fabric of this institution is not questioned. They must remain secure. It is equally clear, however, that in a community of learning willful disruption of the educational process, destruction of property, and interference with the rights of other members of the community cannot be tolerated. Accordingly, it shall be the policy of the University to deal with any such disruption, destruction or interference promptly and effectively, but also fairly and impartially without regard to race, religion, sex or political beliefs.

## **Section 5-2. Definition of Disruptive Conduct**

(a) Any faculty member (the term "faculty member", wherever used in this Chapter V, shall include regular faculty members, full-time instructors, lecturers, and all other persons exempt from the North Carolina State Personnel System [Chapter 126 of the General Statutes as amended] who receive compensation for teaching, or other instructional functions, or research at the University), any graduate student engaged in the instructional program, or any student who, with the intent to obstruct or disrupt any normal operation or function of the University or any of its component institutions, engages, or incites others to engage, in individual or collective conduct which destroys or significantly damages any University property, or which impairs or threatens impairment of the physical well-being of any member of the University community, or which, because of its violent, forceful, threatening or intimidating nature or because it restrains freedom of lawful movement, otherwise prevents any member of the University community from conducting his normal activities within the University, shall be subject to prompt and appropriate disciplinary action, which may include suspension, expulsion, discharge or dismissal from the University.

The following, while not intended to be exclusive, illustrate the offenses encompassed herein, when done for the purpose of obstructing or disrupting any normal operation or function of the University or any of its component institutions: (1) occupation of any University building or part thereof with intent to deprive others of its normal use; (2) blocking the entrance or exit of any University building or corridor or room therein with intent to deprive others of lawful access to or from, or use of, said building or corridor or room; (3) setting fire to or by any other means destroying or substantially damaging any University building or property, or the property of others on University premises; (4) any possession or display of, or attempt or threat to use, for any unlawful purpose, any weapon, dangerous instrument, explosive, or inflammable material in any University building or on any University campus; (5) prevention of, or attempt to prevent by physical act, the attending, convening, continuation or orderly conduct of any University class or activity or of any lawful meeting or assembly in any University building or on any University campus; and (6) blocking normal pedestrian or vehicular traffic on or into any University campus.

(b) Any person engaged in the instructional program who fails or refuses to carry out validly assigned duties, with the intent to obstruct or disrupt any normal operation or function of the University or any of its component institutions, shall be subject to prompt and appropriate disciplinary action under this Chapter V if (but only if) his status is such that he is not subject to the provisions of Section 4-3 of Chapter IV.

### **Section 5-3. Responsibilities of Chancellors**

(a) When any Chancellor has cause to believe that any of the provisions of this Chapter V have been violated, he shall forthwith investigate or cause to be investigated the occurrence, and upon identification of the parties involved shall promptly determine whether any charge is to be made with respect thereto.

(b) If he decides that a charge is to be made, he shall, within thirty (30) days after he has information as to the identity of the alleged perpetrator of the offense but in no event more than twelve (12) months after the occurrence of the alleged offense, (i) refer the case to the appropriate existing University judicial body, or (ii) refer the matter to a Hearing Committee drawn from a previously selected Hearings Panel which, under this option, is required to implement action for violation of Section 5-2 (a) or (b) of this Chapter. If the case is referred to an existing University judicial body under (i) above, the procedural rules of that body shall be followed, and subsections (c) through (f) below shall not be applicable. If the matter is referred to a Hearing Committee under (ii) above, the procedural rules prescribed in subsections (c) through (f) below shall be followed.

(c) The accused shall be given written notice by personal service or registered mail, return receipt requested, stating:

(1) The specific violations of this Chapter V with which the accused is charged.

(2) The designated time and place of the hearing on the charge by the Hearing Committee, which time shall be not earlier than seven (7) nor later than ten (10) days following receipt of the notice.

(3) That the accused shall be entitled to the presumption of innocence until found guilty, the right to retain counsel, the right to present the testimony of witnesses and other evidence, the right to cross-examine all witnesses against him, the right to examine all documents and demonstrative evidence adverse to him, and the right to a transcript of the proceedings of the hearing.

(d) The Hearing Committee shall determine the guilt or innocence of the accused. If the person charged is found guilty, the Hearing Committee shall recommend to the Chancellor such discipline as said body determines to be appropriate. After considering such recommendation the Chancellor shall prescribe such discipline as he deems proper. In any event, whether the person is found guilty or not guilty, a written report shall be made by the Chancellor to the President within ten (10) days.

(e) Any person found guilty shall have ten (10) days after notice of such finding in which to appeal to the President of the University. Such an appeal if taken shall be upon the grounds set forth in Section 5-5.

(f) Any accused person who, without good cause, shall fail to appear at the time and place fixed for the hearing of his case by the Hearing Committee shall be suspended indefinitely or discharged from University employment.

(g) A Chancellor, unless so ordered or otherwise prevented by court, shall not be precluded from carrying out his duties under this Chapter V by reason of any pending action in any State or Federal court. Should a delay occur in prosecuting the charge against the accused because the accused or witnesses

that may be necessary to a determination of the charge are involved in State or Federal court actions, the time limitations set forth above in this Section 5-3 shall not apply.

(h) Conviction in any State or Federal court shall not preclude the University or any of its officers from exercising disciplinary action in any offense referred to in this Chapter V.

(i) Nothing contained in this Chapter V shall preclude the President or any Chancellor from taking any other steps, including injunctive relief or other legal action, which he may deem advisable to protect the best interests of the University.

#### **Section 5-4. Aggravated Acts or Threatened Repetition of Acts**

(a) The Chancellor of each of the component institutions of the University shall appoint an Emergency Consultative Panel which shall be composed of not less than three (3) nor more than five (5) faculty members and not less than three (3) nor more than five (5) students who shall be available to advise with the Chancellor in any emergency. No member of such Panel shall serve for more than one (1) year unless he be reappointed by the Chancellor. The Chancellor may make appointments, either temporary or for a full year, to fill any vacancies which may exist on the Panel.

(b) If, in the judgment of the Chancellor, there is clear and convincing evidence that a person has committed any of the acts prohibited under this Chapter V which, because of the aggravated character or probable repetition of such act or acts, necessitates immediate action to protect the University from substantial interference with any of its orderly operations or functions, or to prevent threats to or acts which endanger life or property, the Chancellor, with the concurrence as hereinafter provided of the Emergency Consultative Panel established pursuant to (a) above, may forthwith suspend such person from the University and bar him from the University campus; provided, however, that in the event of such suspension the person suspended shall be given written notice of the reason for his suspension, either personally or by registered mail addressed to his last known addresses, and shall be afforded a prompt hearing, which, if requested, shall be commenced within ten (10) days of the suspension. Except for purposes of attending personally any hearings conducted under this Chapter V, the bar against the appearance of the accused on the University campus shall remain in effect until final judgment has been rendered in his case and all appellant proceedings have been concluded, unless such restriction is earlier lifted by written notice from the Chancellor.

(c) A quorum of the Emergency Consultative Panel provided for in (a) above shall consist of not less than four (4) of its members, and the required concurrence shall have been obtained if a majority of such quorum shall indicate their concurrence. The Chancellor shall meet personally with members of such Panel at the time he seeks concurrence, if it is feasible to do so. However, if the circumstances are such that the Chancellor deems it not to be feasible to personally assemble such members, then he may communicate with them or the required number of them individually by telephone or by such other means as he may choose to employ, in which event he may proceed as provided in (b) above after the required majority of such members have communicated their concurrence to him.

(d) In the Chancellor's absence or inability to act, the President may exercise the powers of the Chancellor specified in this Section 5-4 in the same

manner and to the same extent as could the Chancellor but for such absence or inability to act.

### **Section 5-5. Right of Appeal**

Any person found guilty of violating the provisions of this Chapter V by the Hearing Committee referred to in Section 5-3 shall have the right to appeal the finding and the discipline imposed upon him to the President of the University. Any such appeal shall be in writing, shall be based solely upon the record, and shall be limited to one or more of the following grounds:

- (1) That the finding is not supported by substantial evidence;
- (2) That a fair hearing was not accorded the accused; or
- (3) That the discipline imposed was excessive or inappropriate.

It shall be the responsibility of the President to make prompt disposition of all such appeals, and his decision shall be rendered within thirty (30) days after receipt of the complete record on appeal.

### **Section 5-6. No Amnesty**

No administrative official, faculty member, or student of the University shall have authority to grant amnesty or to make any promise as to prosecution or non-prosecution in any court, State or Federal, or before any student, faculty, administrative, or Trustee committee to any person charged with or suspected of violating Section 5-2 (a) or (b) of these Bylaws.

### **Section 5-7. Publication**

The provisions of this Chapter V shall be given wide dissemination in such manner as the President or Chancellors may deem advisable, and shall be printed in the official catalogues which may be issued by each component institution of the University.

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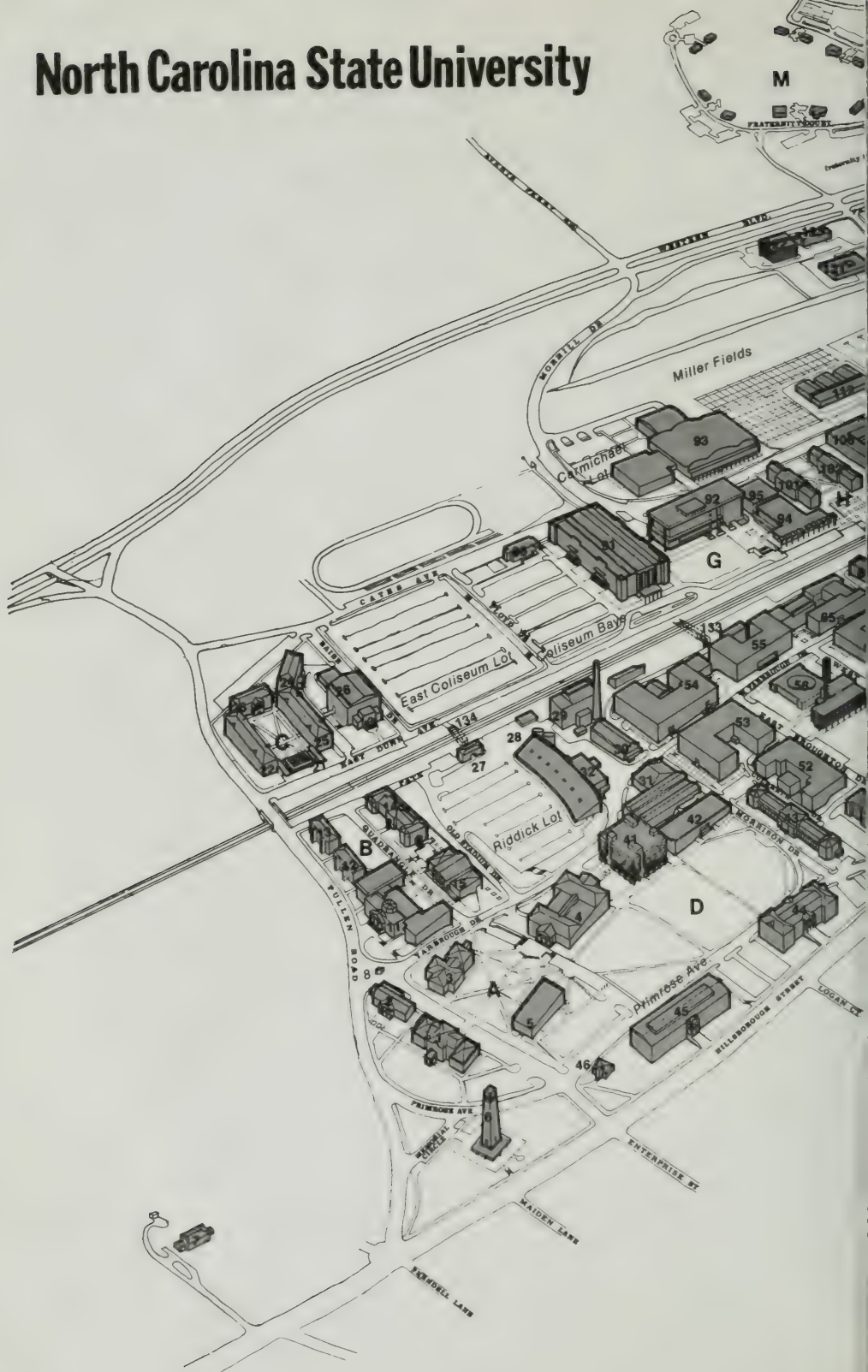
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- A. Holladay Hall Court**
1. Holladay Hall
  2. Alumni Memorial Building
  3. Watauga Hall
  4. Leazar Hall
  5. Peele Hall
  6. Memorial Tower
  7. Chancellor's Residence
  8. Traffic Information Booth
- B. Syme-Brooks Court**
11. Brooks Hall
  12. Gold Hall
  13. Welch Hall
  14. Syme Hall
  15. King Religious Center
- C. Becton-Berry Quadrangle**
21. Quad Snack Bar
  22. Bagwell Hall

23. Berry Hall
  24. Clark Hall Infirmary
  25. Becton Hall
  26. Frank Thompson Theater
  27. Field House
  28. Car Wash
  29. Power Plant
  30. Laundry
  31. Park Shops
  32. Morris Building and West Riddick Stands
- D. Court of North Carolina**
41. Poe Hall
  42. Page Hall
  43. 1911 Building
  44. Winston Hall
  45. Tompkins Hall
  46. Primrose Hall
- E. Gardner Arboretum**
51. Ricks Hall
  52. Withers Hall
  53. Daniels Hall
  54. Riddick Engineering Laboratories
  55. Mann Hall
  56. Burlington Engineering Laboratories
  57. Patterson Hall
- F. University Plaza**
61. D.H. Hill Library—original wing
  62. D.H. Hill Library—book stack tower
  63. D.H. Hill Library—Erdahl-Cloyd wing
  64. Polk Hall
  65. Broughton Hall
  66. Bureau of Mines
  67. Cox Hall
  68. Harrelson Hall
  69. Dabney Hall
  70. Williams Hall

71. Gardner Hall Addition
  72. Gardner Hall
  73. Phytotron
  74. Scott Hall
  75. Kilgore Hall
  76. Horticulture Headhouse and Greenhouses
  77. Botany-Entomology-Genetics-Plant Pathology Headhouse and Greenhouses
  78. Plant Pathology Headhouse and Greenhouses
  79. Crop Science-Soil Science Headhouse and Greenhouses
  80. Clark Laboratories
  81. Nelson Textile Building
- G. University Student Center Plaza**
91. William Neal Reynolds Coliseum
  92. University Student Center
  93. Carmichael Gymnasium
  94. Students Supply Store
  95. Music Building
  96. Case Athletics Center
- H. Turlington-Alexander Court**
101. Alexander Hall
  102. Turlington Hall
- J. Tucker-Owen Court**
106. Owen Hall
  107. Tucker Hall
  108. Harris Cafeteria
  109. Bowen Hall
  110. Metcalf Hall
  111. Carroll Hall
  112. Physical Plant Maintenance Shop
  113. Print Shop
- K. Lee-Bragow Court**
116. Bragow Hall
  117. Lee Hall
  118. Sullivan Hall
- L. Western Boulevard Court**
121. Hodges Wood Products Laboratory
  122. Biltmore Hall
  123. Robertson Wing of Biltmore Hall
  124. Weaver Laboratories
  125. Grinnell Animal Health Laboratory
  126. Schaub Food Science Building
  127. WUNC-TV
  128. Agricultural Experiment Station—Old Central Station
  129. Central Stores
- Railroad Underpasses**
131. Pedestrian Underpass—Dan Allen Drive
  132. Pedestrian Underpass—Students Supply Store
  133. Pedestrian Underpass—Coliseum
  134. Pedestrian Underpass—Riddick Lot
- M. Fraternity Court**
- N. McKimmon Village (Married Student Housing)**
- O. 840 Method Road Greenhouses**





